

AD-753 207

COMPENDIUM OF SPEECH TESTING MATERIAL  
AND TYPICAL NOISE SPECTRA FOR USE IN  
EVALUATING COMMUNICATIONS EQUIPMENT

J. C. Webster

Naval Electronics Laboratory Center  
San Diego, California

13 September 1972

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**TECHNICAL DOCUMENT 191**

**COMPENDIUM OF  
SPEECH TESTING MATERIAL  
AND  
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FOR USE IN EVALUATING  
COMMUNICATIONS EQUIPMENT**

**Explanatory material, lists, and answer sheets allow  
selection of tests appropriate to needs**

**J. C. Webster**

**13 September 1972**

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**NATIONAL TECHNICAL  
INFORMATION SERVICE**  
U S Department of Commerce  
Springfield VA 22151

**Human Factors Technology Division  
NAVAL ELECTRONICS LABORATORY CENTER  
San Diego, California 92152**

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

Naval Electronics Laboratory Center  
San Diego, California 92152

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

COMPENDIUM OF SPEECH TESTING MATERIAL AND TYPICAL NOISE SPECTRA FOR USE  
IN EVALUATING COMMUNICATIONS EQUIPMENT

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Handbook

5. AUTHOR(S) (First name, middle initial, last name)

J. C. Webster

6. REPORT DATE

13 September 1972

7a. TOTAL NO. OF PAGES

98 99

7b. NO. OF REFS

51

8a. CONTRACT OR GRANT NO

b. PROJECT NO SF39.511.001, Task 15222  
(NELC N514)

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

TD 191

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned  
this report)

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

Naval Ship Systems Command

13. ABSTRACT

This compendium of speech tests and typical naval noise spectra was assembled to meet the recurring need for good speech tests for evaluation of speech communication systems. Because of the complex nature of spoken language, many facets of language and test design must be specified before a quantitative score has meaning. These points are treated briefly here, and published material is referenced for the reader who has need for further details.

UNCLASSIFIED

Security Classification

14

KEY WORDS

LINK A

LINK B

LINK C

ROLE

WT

ROLE

WT

ROLE

WT

Speech intelligibility

Communication system evaluation

Naval noise

Human engineering

II

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## INTRODUCTION

At least once a year over the past 25 years the Psychoacoustics Branch of the Human Factors Technology Division has been asked for a good (appropriate, meaningful, expeditious, scientific, quantitative) speech (word, sentence, navy phrase) test for evaluating (proving, condemning, whitewashing) a speech communication system (component, equipment, circuit). There are, in fact, at least 10 standardized tests that can, when properly chosen, give reliable (repeatable) scores varying from 50% to 95% on the same "test system." This apparent anomaly exists not because speech scientists do not know their business but because of the extreme redundancy of spoken language. There are many facets of language and test design that must be understood, controlled, and specified before any quantitative score (percentage of words or sentences correct) really has any meaning. Since this document is not meant to be a comprehensive treatise on the subject but more of a handbook or guide, these points are mentioned only in the briefest form. Reference is made to published papers and books for more details.

Actual lists and answer sheets are included so that anyone can choose a test ONCE HE UNDERSTANDS WHICH TEST IS APPROPRIATE FOR HIS NEEDS.

## LANGUAGE FACTORS AFFECTING INTELLIGIBILITY

### VOCABULARY SIZE AND PHONETICALLY BALANCED WORD TESTS

The potential size of the word lists from which either the talker or the listener makes his selection affects the intelligibility score. If both talker and listener know that only two words will be transmitted – say, "yes" and "no" – a score of 50% will result from chance alone and scores near 100% can well be expected. If only the digits zero through nine(r) are transmitted, chance scores of 10% will occur and scores above 90% can be expected.

The oldest and most respected of commonly used word tests was compiled by Egan (1948) during World War II. Egan compiled 1000 monosyllabic words, then arranged them in 20 lists of 50 words so that each list was "phonetically balanced." That is, within each list the phonetic balance of the English language as a whole was accurately represented. These phonetically balanced (PB) words are listed in exhibit 1. Each word is followed by a numeral from 1 to 20 specifying the list it is to be used in.

To give the test, separate the words into the 20 lists and randomize the word order (do not read them alphabetically). The listener copies on plain paper what he hears. Spelling is NOT crucial – "aisle" equals "isle."

Caution. These tests are difficult to administer, score, and interpret. Talker and listening crews must be trained for weeks. A gap of 4 seconds must be allowed between words (to give listener time to write). The talkers must use a carrier phrase such as, "Number one, you will write the word \_\_\_\_\_ now." In tightly controlled tests, the talker should monitor each transmission to get the same voice level or intensity (reading on a VU, or equivalent, meter) on the word "word." Assuming the talker/listener crews

# EXHIBIT 1: EGAN'S 1000 PHONETICALLY BALANCED MONOSYLLABIC WORDS.

1. ACE	20	51. BECK	5	101. CAMP	10	151. CLOG	20	201. DAB	2
2. ACHE	3	52. BEE	4	102. CANE	1	152. CLOSED	16	202. DAD	6
3. ACT	7	53. BEEF	9	103. CANT	19	153. CLOTH	6	203. DAME	16
4. ADD	5	54. BELL	15	104. CAPE	3	154. CLOTHER	10	204. DARN	14
5. AGE	19	55. BEST	6	105. CAR	14	155. CLOTHES	6	205. DART	17
6. AID	16	56. BET	7	106. CART	20	156. CLOUD	2	206. DASH	14
7. AIL	10	57. BID	8	107. CARVE	9	157. CLOVE	1	207. DAUB	10
8. AIM	7	58. BIG	17	108. CASE	17	158. CLOWN	9	208. DAY	8
9. AIMS	18	59. BIND	8	109. CAST	3	159. CLUB	9	209. DEAD	14
10. AIR	3	60. BIRTH	9	110. CAT	18	160. CLUE	17	210. DEAF	13
11. ALL	17	61. BIT	9	111. CATCH	8	161. CLUTCH	12	211. DEATH	1
12. AM	7	62. BLACK	5	112. CAVE	12	162. COAST	7	212. DEBT	18
13. AND	12	63. BLESS	18	113. CHAFE	12	163. COAX	14	213. DECK	3
14. APT	17	64. BLIND	15	114. CHAFF	18	164. COB	6	214. DEED	1
15. ARC	11	65. BLISS	11	115. CHAIN	18	165. COD	8	215. DEEP	6
16. ARCH	9	66. BLONDE	4	116. CHAIR	12	166. CODE	11	216. DEPTH	12
17. ARE	1	67. BLUFF	12	117. CHAMP	10	167. COMES	7	217. DEUCE	8
18. ARM	11	68. BLUSH	2	118. CHANCE	10	168. COOK	7	218. DICE	18
19. ART	18	69. BOB	10	119. CHANGE	13	169. CORD	10	219. DID	20
20. AS	6	70. BOG	6	120. CHANT	8	170. CORK	20	220. DIG	3
21. ASK	8	71. BOLT	8	121. CHAP	12	171. CORN	13	221. DIKE	1
22. ASS	12	72. BOOK	16	122. CHARGE	2	172. CORPSE	2	222. DILL	3
23. AT	14	73. BOOST	9	123. CHART	6	173. COST	15	223. DIME	12
24. AWE	2	74. BOOTH	17	124. CHAT	19	174. COURSE	4	224. DIN	16
25. AXE	18	75. BORED	8	125. CHEAP	15	175. COURT	4	225. DINE	17
26. BACK	10	76. BOSS	15	126. CHEAT	5	176. COW	10	226. DIP	11
27. BAD	1	77. BOUGH	15	127. CHECK	3	177. CRAB	18	227. DISH	1
28. BADGE	6	78. BOUGHT	2	128. CHEESE	16	178. CRACK	8	228. DITCH	9
29. BAIT	2	79. BOUNCE	2	129. CHESS	9	179. CRAS.	1	229. DIVE	15
30. BALD	3	80. BOX	1	130. CHEST	9	180. CRATE	20	230. DODGE	4
31. BAILE	18	81. BRACE	17	131. CHEW	8	181. CRAVE	3	231. DOG	13
32. BALL	12	82. BRAID	17	132. CHILL	18	182. CREED	1	232. DONE	12
33. BAR	1	83. BRASS	20	133. CHINK	12	183. CREWS	16	233. DOPE	7
34. BARB	3	84. BRONZE	5	134. CHIP	18	184. CRIB	6	234. DOSE	7
35. BARGE	16	85. BROWSE	5	135. CHOOSE	5	185. CRIME	3	235. DOT	18
36. BARK	19	86. BUCK	17	136. CHOP	7	186. CROWD	9	236. DOUBT	11
37. BARN	14	87. BUD	2	137. CHOSE(CHÖZ)	19	187. CRUDE	19	237. DOUGH	19
38. BASE	20	88. BUDGE	4	138. CHUNK	11	188. CRUSH	17	238. DOUSE	14
39. BASH	10	89. BUG	10	139. CLASH	11	189. CRUTCH	11	239. DOVE(DUV)	15
40. PASK	1	90. BUS	4	140. CLASS	3	190. CRY	11	240. DRAPE	16
41. BAT	13	91. BUSH	4	141. CLAW	18	191. CUB	18	241. DRAKE	11
42. BATH	4	92. BUST	14	142. CLAWS	18	192. CUD	9	242. DROOP	16
43. BATHE	5	93. BUT	7	143. CLEANSE	1	193. CUE	10	243. DROP	3
44. BAY	19	94. BUZZ	19	144. CLICK	20	194. CUFF	15	244. DRUG	19
45. BEAD	3	95. BY	7	145. CLIFF	16	195. CUP	19	245. DUB	16
46. BEAM	11	96. CAB	19	146. CLIMB	13	196. CURB	13	246. DUKE	20
47. BEAN	2	97. CAD	12	147. CLING	12	197. CURSE	5	247. DULL	11
48. BEARD	20	98. CAGE	19	148. CLIP	14	198. CURVE	14	248. DUMB	8
49. BEAST	4	99. CALF	8	149. CLOAK	4	199. CUT	7	249. DUNE	19
50. BEAU	13	100. CALVE	19	150. CLOD	8	200. CUTE	14	250. DUNG	14

EXHIBIT 1 (Continued).

251. DUPE	4	301. FIT	17	351. FUSE	9	401. HAT	10	451. ITCH	9
252. DWARF	7	302. FIVE	2	352. FUSS	1	402. HATCH	4	452. JAB	11
253. EACH	8	303. FLAG	9	353. GAB	16	403. HATE	13	453. JADE	15
254. EARL	2	304. FLAME	15	354. GAGE	6	404. HAVE	11	454. JAG	6
255. EARN	4	305. FLANK	19	355. GANG	20	405. HEAP	1	455. JAM	3
256. EARS	10	306. FLAP	5	356. GAP	6	406. HEAV	12	456. JAUNT	11
257. EARTH	10	307. FLARE	18	357. GAPE	5	407. HEAT	14	457. JAW	12
258. EASE	8	308. FLASH	20	358. GAS	16	408. HEDGE	15	458. JAY	10
259. EAT	6	309. FLAUNT	10	359. GASH	15	409. HEED	4	459. JAZZ	12
260. EBB	19	310. FLEET	15	360. GASP	7	410. HENCE	17	460. JELL	8
261. EDGE	15	311. FLICK	6	361. GATE	9	411. HID	1	461. JIG	13
262. EEL	4	312. FLIGHT	10	362. GEM	13	412. HIDE	18	462. JOB	2
263. ELF	15	313. FLING	7	363. GET	20	413. HIGH	5	463. JOKE	20
264. ELK	13	314. FLIP	8	364. GILL	2	414. HIKE	19	464. JOLT	12
265. ELM	13	315. FLOAT	4	365. GIN	19	415. HILL	5	465. JUDGE	20
266. ELSE	2	316. FLOG	12	366. GIVE	9	416. HIM	7	466. JUG	7
267. END	1	317. FLOOD	12	367. GLOSS	2	417. HIRE	2	467. KEFT	6
268. ETCH	10	318. FLOP	6	368. GLOVE	15	418. HIS	18	468. KEY	9
269. EYE	20	319. FLUFF	9	369. GNASH	12	419. HISS	4	469. KICK	14
270. EYES	6	320. FLUSH	3	370. GNAW	3	420. HIT	2	470. KID	5
271. FACT	15	321. FOAM	14	371. GOAT	11	421. HITCH	6	471. KILL	8
272. FAD	8	322. FOE	9	372. GOR	20	422. HIVE	1	472. KIND	16
273. FADE	18	323. FOLD	13	373. GOD	19	423. HOCK	2	473. KISS	15
274. FAIR	20	324. FOLK	1	374. GOLF	15	424. HOG	11	474. KIT	11
275. FAKE	7	325. FOND	19	375. GOOD	5	425. HOLE	15	475. KITE	4
276. FAIL	6	326. FOOD	8	376. GOOSE	10	426. HOOD	17	476. KNEE	16
277. FALLS	17	327. FOOL	18	377. GOT	18	427. HOOF	9	477. KNIFE	12
278. FAME	3	328. FOOT	12	378. GRAB	18	428. HOOK	13	478. KNIT	7
279. FAN	19	329. FOR	13	379. GRACE	9	429. HOSE	16	479. LAD	19
280. FAR	3	330. FORCE	10	380. GRADE	7	430. HOT	4	480. LAG	11
281. FAST	20	331. FORD	1	381. GRAPE	13	431. HOW	4	481. LAP	10
282. FAT	18	332. FORGE	6	382. GRATE	14	432. HOWL	14	482. LASH	12
283. FATE	2	333. FORM	17	383. GRAVE	13	433. HUG	12	483. LAST	17
284. FEAST	1	334. FORT	7	384. CRAY	18	434. HULL	6	484. LATCH	11
285. FED	12	335. FORTH	8	385. GREEK	5	435. HUM	8	485. LATHE	14
286. FEE	6	336. FOUGHT	12	386. GREET	12	436. HUMP	20	486. LAUGH	12
287. FEED	5	337. FOWL	6	387. GREW	18	437. HUNCH	12	487. LAW	3
288. FEEL	11	338. FRAUD	1	388. GROPE	6	438. HUNK	14	488. LAY	16
289. FEET	17	339. FREAK	8	389. GROUP	14	439. HUNT	1	489. LEASH	16
290. FELL	17	340. FREEZE	18	390. GROVE	1	440. HURL	3	490. LEAVE	3
291. FERN	1	341. FRESH	17	391. GRUDGE	5	441. HURT	10	491. LED	19
292. FEW	13	342. FRIGHT	16	392. GUESS	8	442. HUSH	18	492. LEDGE	12
293. FIFE	14	343. FRILL	12	393. GULL	10	443. HUT	19	493. LEFT	8
294. FIFTH	16	344. FRISK	11	394. GUM	17	444. ICE	9	494. LEG	6
295. FIG	3	345. PROCK	8	395. GUN	7	445. IF	17	495. LEND	5
296. FILL	13	346. FROG	2	396. GUSH	18	446. IN	20	496. LESS	15
297. FIN	4	347. FRONT	8	397. CYP	19	447. INCH	5	497. LICK	8
298. FIND	19	348. FROWN	4	398. HACK	13	448. INK	16	498. LID	20
299. FINE	11	349. FUDGE	11	399. HAD	16	449. IS	1	499. LIFE	14
300. FIR	10	350. FUME	9	400. HASH	16	450. ISLE	14	500. LIME	18

EXHIBIT 1 (Continued).

501. LINE	10	551. NAB	2	601. PACK	20	651. PROBE	11	701. RICE	11
502. LIP	18	552. NAG	13	602. PACT	9	652. PROD	11	702. RICH	7
503. LIT	9	553. NAP	16	603. PAD	20	653. PRUDE	14	703. RID	14
504. LOG	2	554. NAUGHT	15	604. PAGE	10	654. PUFF	5	704. RIDE	1
505. LOOK	8	555. NEAT	4	605. PAID	17	655. PUG	13	705. RIDGE	17
506. LOOGE	12	556. NECK	3	606. PAN	1	656. PULSE	3	706. RIND (RIND)	5
507. LOSE (LOOZ)	19	557. NEED	2	607. PANTS	1	657. PUMP	16	707. RIT	10
508. LOSS	11	558. NERVE	9	608. PARE	17	658. PUN	6	708. RIPE	12
509. LOUD	18	559. NEST	3	609. PARK	12	659. PUNK	11	709. RISE	1
510. LOUSE	16	560. NET	11	610. PART	16	660. PUNT	5	710. RISK	11
511. LOVE	5	561. NEW	4	611. PASS	5	661. PUP	15	711. ROAM	17
512. LOW	11	562. NEWS	14	612. PAST	17	662. PURGE	14	712. ROAR	7
513. LUNGE	18	563. NEXT	16	613. PASTE	19	663. PURSE	11	713. ROB	18
514. LUSH	3	564. NICE	13	614. PATCH	13	664. PUS	6	714. ROBE	20
515. LUST	19	565. NICK	14	615. PATH	3	665. PUSS	20	715. ROCK	16
516. LYNCH	18	566. NIECE	2	616. PEARL	17	666. PUT	10	716. ROD	8
517. MA	17	567. NIGH	6	617. PECK	4	667. QUACK	14	717. RODE	5
518. MADE	13	568. NIGHT	8	618. PEY	17	668. QUART	2	718. ROE	5
519. MANGE	1	569. NINE	7	619. PFLT	13	669. QUEEN	8	719. ROGUE	16
520. MAP	16	570. NINTH	15	620. PENT	7	670. QUICK	15	720. ROLL	8
521. MASH	6	571. NIP	13	621. PERCH	19	671. QUIP	20	721. ROMP	12
522. MASS	9	572. NO	1	622. PERK	2	672. QUIZ	7	722. ROOMS	6
523. MAST	5	573. NOD	14	623. PERT	4	673. RACE	4	723. ROOST	20
524. MAY	15	574. NOOK	1	624. PEST	1	674. RACK	4	724. ROOT	9
525. MAZE	10	575. NOOSE	9	625. PEW	20	675. RAFT	19	725. ROPE	8
526. ME	14	576. NOSE	5	626. PHASE	7	676. RAG	1	726. ROSE	18
527. MERGE	4	577. NOT	1	627. PHONE	9	677. RAGE	17	727. ROT	8
528. MESH	15	578. NOTCH	19	628. PICK	2	678. RAID	7	728. ROTE	19
529. MIST	17	579. NOTE	18	629. PIG	7	679. RAISE	6	729. ROUGE	20
530. MITT	15	580. NUDGE	10	630. PILE	1	680. RAMP	20	730. ROUGH	6
531. MODE	15	581. NUT	2	631. PINCH	4	681. RANGE	7	731. ROUSE	3
532. MOOD	13	582. NUTS	9	632. PINK	10	682. RAP	2	732. ROUT (ROWT)	20
533. MOOSE	2	583. OAK	3	633. PINT	8	683. RAPE	10	733. ROVE	12
534. MOP	13	584. OATH	15	634. PIPE	5	684. RASH	7	734. RUB	1
535. MOPE	10	585. ODD	9	635. PIT	2	685. RAT	1	735. RUDE	9
536. MORI	15	586. ODDS	5	636. PITCH	16	686. RATE	3	736. RUG	16
537. MORT	11	587. ODE	6	637. PLEAD	13	687. RAVE	4	737. RULE	19
538. MOTE	7	588. OFF	7	638. PLEASE	3	688. RAW	4	738. RUSH	10
539. MOTH	13	589. OFT	14	639. PLOD	7	689. RAY	6	739. RUT	4
540. MOUTH	11	590. OILS	4	640. PLOW	17	690. REACH	17	740. RYE	16
541. MOVE	4	591. ON	19	641. PLUS	10	691. REAL	10	741. SACK	18
542. MOV (MO)	20	592. OR	4	642. PLUSH	1	692. REAP	6	742. SAG	7
543. MUCK	3	593. OUCH	18	643. POD	4	693. REAR	5	743. SAGE	4
544. MUD	7	594. OUGHT	13	644. POND	11	694. REED	9	744. SALVE	20
545. MUFT	13	595. OUR	2	645. POUNCE	7	695. REEF	11	745. SANG	16
546. MUSH	13	596. OUT	12	646. PRESS	17	696. REEK	12	746. SAP	11
547. MUSS	14	597. OWE	13	647. PRICE	13	697. REST	8	747. SASH	18
548. MUTE	2	598. OWLS	5	648. PRIEST	12	698. RETCH	20	748. SAT	19
549. MY	13	599. OWN	15	649. PRIG	6	699. RHYME	8	749. SCAB	4
550. MYTH	17	600. OX	17	650. PRIME	6	700. RIB	2	750. SCAN	6

# EXHIBIT 1 (Continued).

751. SCARE	5	801. SLAP	4	851. STRIFE	1	901. TILE	12	951. WASP	6
752. SCOUT	7	802. SLASH	15	852. STUFF	14	902. TILL	8	952. WASTE	18
753. SCOW	15	803. SLED	13	853. SUCH	1	903. TILT	20	953. WATCH	5
754. SCRATCH	17	804. SLEDGE	7	854. SUCK	2	904. TIME	15	954. WAVE	11
755. SCRUB	10	805. SLICE	20	855. SUIT	16	905. TINGE	15	955. WAYS	2
756. SCUFF	13	806. SLID	19	856. SUP	6	906. TIP	13	956. WEAK	9
757. SCYTHE	2	807. SLIDE	8	857. TAB	11	907. TIRE	16	957. WEAN	13
758. SEED	20	808. SLIP	1	858. TACK	15	908. TOAD	9	958. WEAVE	15
759. SELL	17	809. SLOUCH	6	859. TAG	10	909. TOE	1	959. WEB	20
760. SENSE	15	810. SLUDGE	2	860. TAINT	13	910. TOIL	3	960. WED	15
761. SET	12	811. SLUG	10	861. TAKE	3	911. TON	16	961. WEDGE	3
762. SHACK	8	812. SLUSH	20	862. TAN	2	912. TONGUE	6	962. WEE	18
763. SHADE	15	813. SLY	5	863. TANG	2	913. TOUCH	4	963. WEEP	17
764. SHAFT	7	814. SMART	9	864. TAP	13	914. TRADE	5	964. WEIRD	17
765. SHANK	6	815. SHAM	13	865. TEACH	15	915. TRASH	2	965. WHARF	3
766. SHARE	18	816. SMILE	1	866. TELL	14	916. TRAY	14	966. WHEAT	1
767. SHED	4	817. SMITE	14	867. TEN	9	917. TREE	10	967. WHEEL	19
768. SHEEP	16	818. SMOOTH	13	868. TENT	14	918. TRIP	3	968. WHEEZE	8
769. SHEIK	16	819. SNIFF	7	869. TEST	4	919. TROD	18	969. WHIMF	7
770. SHIN	4	820. SNIPE	10	870. THAN	9	920. TROOP	9	970. WHITE	19
771. SHINE	5	821. SNOW	11	871. THANK	9	921. TRUE	5	971. WHO	3
772. SHIP	17	822. SNUFF	2	872. THAT	15	922. TUBE	17	972. WHY	3
773. SHOCK	17	823. SO	15	873. THAW	13	923. TUCK	16	973. WIDE	15
774. SHOE	2	824. SOAK	20	874. THEM	2	924. TUG	5	974. WIELD	16
775. SHOOK	14	825. SOAP	13	875. THEMSE	20	925. TURF	3	975. WIFE	6
776. SHOP	11	826. SOAR	16	876. THEN	1	926. TURN	16	976. WIG	8
777. SHOT	11	827. SOB	3	877. THERE	1	927. TWEED	15	977. WILD	9
778. SHOUT	3	828. SOD	12	878. THICK	5	928. UP	19	978. WINK	5
779. SHOVE	5	829. SCIL	14	879. THIEF	19	929. URGE	11	979. WINE	17
780. SHRUB	15	830. SOLVE	5	880. THIGH	6	930. US	8	980. WIPE	9
781. SHRUG	14	831. SOUR	4	881. THIN	13	931. USE(YEWS)	1	981. WIRE	7
782. SHUT	12	832. SOUSE	20	882. THINE	18	932. VAGUE	14	982. WISE	20
783. SHY	19	833. SOUTH	7	883. THIS	8	933. VALVE	10	983. WISH	2
784. SICK	5	834. SPED	3	884. THORN	18	934. VAMP	2	984. WITH	9
785. SIDE	13	835. SPICE	8	885. THOSE	10	935. VASE(VACE)	5	985. WOE	7
786. SIEGE	7	836. SPLASH	19	886. THOU	16	936. VAST	2	986. WOO	7
787. SIEVE	18	837. SPRIG	11	887. THOUGH	7	937. VICE	17	987. WOOD	11
788. SIGH	20	838. SPUD	9	888. THRASH	3	938. VILE	15	988. WOVE	12
789. SIGN	11	839. SPY	11	889. THREAD	8	939. VINE	12	989. WRATH	5
790. SILL	19	840. STAB	16	890. THREE	16	940. VOID	10	990. WRECK	15
791. SIN	7	841. STAFF	10	891. THRESH	16	941. VOTE	14	991. WRIST	14
792. SING	14	842. STAG	3	892. THROAT	19	942. VOW	3	992. WRIT	6
793. SIP	9	843. START	2	893. THROB	12	943. WADE	10	993. YAWN	5
794. SIR	15	844. STARVE	4	894. THRONE	9	944. WAG	14	994. YEAR	9
795. SIT	3	845. STEAD	13	895. THROUGH	20	945. WAGE	12	995. YEAST	8
796. SIZE	3	846. STEED	19	896. THUD	5	946. WAIF	14	996. YES	19
797. SKETCH	4	847. STIFF	11	897. THUG	10	947. WAIT	6	997. YIELD	19
798. SKID	20	848. STRAP	4	898. THUS	6	948. WAKE	10	998. YOU	17
799. SKY	12	849. STRESS	16	899. TIY	14	949. WALK	20	999. YOUTH	10
800. SLAB	14	850. STRIDE	17	900. TICK	4	950. WASH	20	1000. ZONE	5

are adequately trained, the scores are dependent upon the size of vocabulary chosen. Repeated scores on a single 50-word list will typically be as much as 50 percentage points higher than if five lists are used. Similarly, scores on 250 words can be up to 40 percentage points higher than scores when all 1000 words are used; see figure 4-5 in Kryter, Licklider, Webster, and Hawley (1963), reproduced as figure 1.

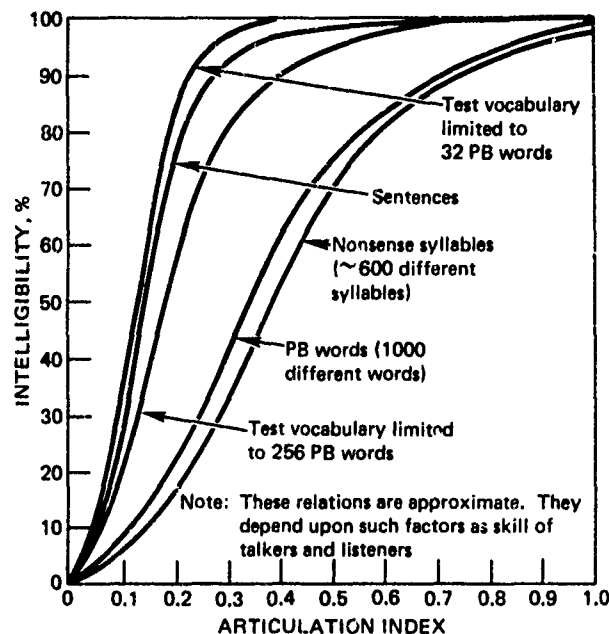


Figure 1. Sentence, PB word, and nonsense syllable intelligibility as a function of articulation index (AI).

These lists should be used with great caution, but they are excellent for evaluating GOOD SYSTEMS, or comparing one system to another, because they are sensitive to small changes AND they have been widely used in the past. Many specifications and/or comparisons to older systems will be in PB scores.

Egan (1948) recognized occasions would arise in which only 100 PB's were needed, so he constructed two R-lists. In his words, "The words were selected so that they resemble one another as much as possible.... the 15 vowels and diphthongs are represented by six words each. An effort was made to distribute all the different consonant sounds among these 90 words. The remaining 10 words.... are used to sample some of the compound consonants."

If 100 PB words are required for use with relatively untrained crews, randomize the R-lists shown in exhibit 2.

EXHIBIT 2: EGAN'S R-LISTS (100 SELECTED PB WORDS).

R LIST 1

1. aisle	21. dame	41. jack	61. rack	81. still
2. barb	22. done	42. jam	62. ram	82. tale
3. barge	23. dub	43. law	63. ring	83. tame
4. bark	24. feed	44. lawn	64. rip	84. toil
5. baste	25. feet	45. lisle	65. rub	85. ton
6. bead	26. file	46. live	66. run	86. trill
7. beet	27. five	47. loon	67. sale	87. tub
8. beige	28. foil	48. loop	68. same	88. vouch
9. boil	29. fume	49. mess	69. shod	89. vow
10. choke	30. fuse	50. met	70. shop	90. whack
11. chore	31. get	51. neat	71. should	91. wham
12. cod	32. good	52. need	72. shrill	92. woe
13. coil	33. guess	53. oil	73. sing	93. woke
14. coon	34. hews	54. ouch	74. sip	94. would
15. coop	35. hive	55. paw	75. skill	95. yaw
16. cop	36. hod	56. pawn	76. soil	96. yawn
17. couch	37. hood	57. pews	77. soon	97. yes
18. could	38. hop	58. poke	78. soot	98. yet
19. cow	39. how	59. pour	79. soup	99. zing
20. dale	40. huge	60. pure	80. spill	100. zip

R LIST 2

1. ball	21. dial	41. hen	61. peep	81. tap
2. bar	22. dig	42. huff	62. peeve	82. them
3. bob	23. dine	43. hush	63. phase	83. then
4. bong	24. ditch	44. jar	64. pull	84. title
5. book	25. doubt	45. job	65. put	85. tine
6. boot	26. dowel	46. joy	66. raid	86. tong
7. booth	27. drain	47. joys	67. raze	87. toot
8. bout	28. em	48. kirk	68. rich	88. tooth
9. bowel	29. en	49. leap	69. rig	89. tout
10. boy	30. fade	50. leave	70. ream	90. towel
11. boys	31. far	51. made	71. roe	91. toy
12. brain	32. foam	52. maize	72. root	92. toys
13. bull	33. fob	53. mew	73. rough	93. weave
14. crane	34. foe	54. muff	74. rush	94. weep
15. cue	35. foot	55. mush	75. ruth	95. while
16. curb	36. full	56. mute	76. sack	96. whine
17. curd	37. gall	57. new	77. sap	97. wig
18. curse	38. gong	58. newt	78. slain	98. witch
19. curt	39. grain	59. oh	79. tack	99. yak
20. cute	40. hem	60. ohm	80. tall	100. yap

## WORD FREQUENCY (FAMILIARITY) EFFECTS

Not only is the size of the vocabulary a determinant of speech intelligibility but also the relative familiarity of the word; that is, how often the word occurs in the language. See Howes (1957), Egan (1957), Rosenzweig (1957), and Rosenzweig and Postman (1957). Therefore, Hirsh et al (1952), Lehiste and Peterson (1959), Peterson and Lehiste (1962), Carhart, Tillman, and Wilbur (1963), Tillman, Carhart, and Wilbur (1965), and Tillman and Carhart (1966) compiled lists of more familiar PB or CNC\* words. Exhibit 3 gives the Hirsh et al (1952) lists of 200 words known as CID Test W-22. Exhibit 4 gives the Peterson and Lehiste (1962) lists of 500 words, and exhibit 5 gives the Tillman and Carhart (1966) lists of the 200 words known as Northwestern University Auditory Test 6 developed for the Air Force. NU Auditory Test 6 was designed for greater homogeneity among lists than the W-22. If 200 PB words are desired, randomize exhibit 5, and if 500 are required, randomize exhibit 4. Exhibit 4 is particularly important because the familiarity of the words in terms of the Thorndike and Lorge (1952) count is given. The words in exhibit 5 are used extensively in the USAF both clinically and for in-flight tests of air crewmen with suspected hearing losses.

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\*Consonant Vowel Nucleus Consonant

EXHIBIT 3: HIRSH ET AL W-22 LISTS (200 FAMILIAR PB WORDS).

<i>List 1</i>	<i>List 2</i>	<i>List 3</i>	<i>List 4</i>
1. ace	1. ail	1. add	1. aid
2. ache	2. air	2. aim	2. all
3. an	3. and	3. are	3. am
4. as	4. been	4. ate	4. arm
5. bathe	5. by	5. bill	5. art
6. bells	6. cap	6. book	6. at
7. carve	7. car	7. camp	7. bee
8. chew	8. chest	8. chair	8. bread
9. could	9. die	9. cute	9. can
10. dad	10. does	10. do	10. chin
11. day	11. dumb	11. done	11. clothes
12. deaf	12. ease	12. dull	12. cock
13. earn	13. eat	13. ears	13. darn
14. east	14. else	14. end	14. dolls
15. felt	15. flat	15. farm	15. dust
16. give	16. gave	16. glove	16. ear
17. high	17. ham	17. hand	17. eyes
18. him	18. hit	18. have	18. few
19. hunt	19. hurt	19. he	19. go
20. isle	20. ice	20. if	20. hang
21. it	21. ill	21. is	21. his
22. jam	22. jaw	22. jar	22. in
23. knees	23. key	23. king	23. jump
24. law	24. knee	24. knit	24. leave
25. low	25. live	25. lie	25. men
26. me	26. move	26. may	26. my
27. mew	27. new	27. nest	27. near
28. none	28. now	28. no	28. net
29. not	29. oak	29. oil	29. nuts
30. or	30. odd	30. on	30. of
31. owl	31. off	31. out	31. ought
32. poor	32. one	32. owes	32. our
33. ran	33. own	33. pie	33. pale
34. see	34. pew	34. raw	34. save
35. she	35. rooms	35. say	35. shoe
36. skin	36. send	36. shove	36. so
37. stove	37. show	37. smooth	37. stiff
38. them	38. smart	38. start	38. tea
39. there	39. star	39. tan	39. tin
40. thing	40. tear	40. ten	40. than
41. toe	41. that	41. this	41. they
42. true	42. then	42. three	42. through
43. twins	43. thin	43. though	43. toy
44. up	44. too	44. tie	44. where
45. us	45. tree	45. use	45. who
46. wet	46. way	46. we	46. why
47. what	47. well	47. west	47. will
48. wire	48. with	48. when	48. wood
49. yard	49. young	49. wool	49. yes
50. you	50. your	50. year	50. yet

*Alphabetical Lists of the Words in Auditory Test W-22*

**EXHIBIT 4: PETERSON AND LEHISTE CNC LISTS  
(500 FAMILIAR PB WORDS).**

CNC List 1		CNC List 2	
Word	Frequency	Word	Frequency
1. bean*	43	1. beam*	41
2. boat	AA 1000	2. beg	A
3. boil	A	3. bought*	A
4. cape*	34	4. car*	AA 500
5. check*	AA	5. choice	A
(chèque)	(2)	6. choose*	A
6. chore	3	7. coat	AA 1000
7. dead*	AA 1000	8. cob*	2
8. dime*	11	9. dam	19
9. ditch*	28	(damn)	(18)
10. fall*	AA 500	10. dire	8
11. fit*	AA 1000	11. dodge*	16
12. gale	15	12. fake*	3
13. goose*	45	13. fern*	13
14. hate*	A	14. gain	AA 1000
15. home	AA 500	15. germ	10
16. hull*	3	16. goal	21
17. jar	43	17. hash*	2
18. jug*	8	18. hide*	A
19. king	AA 500	(hied)	(2)
20. kite*	10	19. hill*	AA 1000
21. knife*	A	20. jet	9
22. lag*	9	21. late	AA 500
23. lease	14	22. lead [lid]	AA 1000
24. loop	15	23. leak	8
25. make	AA 500	(leek)	(1)
26. merge*	6	24. love*	AA 500
27. mess	17	25. met	AA 1000
28. name	AA 500	26. moon	AA
29. pad*	17	27. much	AA 500
30. patch*	34	28. nose*	AA 1000
31. pick*	AA 1000	(knows)	(AA 500)
32. ripe*	34	29. nurse	A
33. rose*	AA 1000	30. pan*	A
(rows)	(A)	31. pave	14
34. rout*	8	32. puff*	28
35. salve*	3	33. rail	A
36. seize	A	34. red	AA 500
(sees)	(AA 500)	35. ring	AA 1000
(seas)	(AA 500)	(wring)	(9)
37. shirt	47	36. root* [rut]	A
38. shore	AA 1000	(route)	(A)
39. sob*	36	37. sap*	18
40. sun	AA 500	38. ship*	AA 500
(son)	(AA 500)	39. should	AA 500
41. thin*	AA 1000	40. soul	AA 1000
42. toad*	15	('sole)	(25)
(towed)	(9)	41. . outh*	AA 1000

## EXHIBIT 4 (Continued).

CNC List 1		CNC List 2	
Word	Frequency	Word	Frequency
43. tooth	47	42. suck*	15
44. tough	18	43. tall	AA 1000
45. van	29	44. talk	AA 500
46. wheel* [mil]	A	45. this*	AA 500
47. wish*	AA 500	46. tire*	AA 1000
48. wood*	AA 1000	47. vine*	38
(would)	(AA 500)	48. wag*	12
49. wreck*	41	49. weep	38
50. yearn	10	50. which [mitf]	AA 500

CNC List 3		CNC List 4	
Word	Frequency	Word	Frequency
1. bar*	A	1. birch	16
2. bell*	A	2. bone	A
(belle)	(13)	3. bug*	10
3. bush*	A	4. can	AA 500
4. chin	27	5. cash	46
5. dab*	2	6. chief	AA 1000
6. dike*	4	7. chum	4
(dyke)	(1)	8. date	AA 1000
7. dip*	34	9. deal	AA 1000
8. fade*	41	10. dose* [do's]	8
9. faith	A	11. foot*	AA 1000
10. four*	AA 500	12. gas*	A
(fore)	(11)	13. give*	AA 500
(for)	(AA 500)	14. him*	AA 500
11. gap*	17	15. hire*	A
12. gull*	5	16. hoof* [huf]	26
13. head	AA 500	17. job*	AA 1000
14. house [haus]	AA 500	18. keep	AA 500
15. hut*	32	19. lap*	36
16. jail	22	20. loan	30
(gaol)	(1)	(lone)	(22)
17. joke*	32	21. long	AA 500
18. keen	35	22. loud*	A
19. keg	3	23. mill	A
20. kid*	A	(mil)	(1)
21. lake	AA 1000	24. mirth	16
22. leave*	AA 500	25. mop*	5
23. life*	AA 500	26. net*	A
24. man	AA 500	27. nice*	AA 1000
25. mate	48	28. pack*	A
26. more	AA 500	29. pause	A
27. noise	A	(paws)	(29)
28. numb	5	30. phone*	20
29. perch*	23	31. pool	34
30. piece	AA 1000	32. rage*	49
(peace)	(AA 1000)	33. read* [rid]	AA 500
31. pod*	3	(reed)	(22)

## EXHIBIT 4 (Continued).

CNC List 3		CNC List 4	
Word	Frequency	Word	Frequency
32. purge*	6	34. rice*	38
33. rat*	37	35. said	AA 500
34. rig	6	36. serve	AA 500
35. room [rum]	AA 500	37. shake	A
36. rouge* [ruʒ]	9	38. shut*	A
37. sheep*	A	39. sock	12
38. shine*	A	40. take*	AA 500
39. size*	AA 1000	41. thumb	27
(sighs)	(A)	42. till*	AA 1000
40. soon	AA 500	43. tower	A
41. sung	16	44. void*	12
42. toll	10	45. wail	20
43. tone	A	46. war	AA 500
44. toss	46	(wore)	(A)
45. vote*	AA	47. when [men]	AA 500
46. well	AA 500	48. wig*	10
47. what [Mat]	AA 500	49. write	AA 500
48. with* [wið]	AA 500	(right)	(AA 500)
49. work	AA 500	50. youth*	AA
50. yam	1		

CNC List 5		CNC List 6	
Word	Frequency	Word	Frequency
1. back*	AA 500	1. bad*	AA 1000
2. bathe*	39	2. bed	AA 1000
3. beach	A	3. birth*	A
(beech)	(10)	4. bud*	30
4. boot	37	5. cage*	30
5. cab*	15	6. calf*	14
6. care	AA 500	7. cat*	A
7. chalk	13	8. chain*	AA 1000
8. coal	AA 1000	9. cheese*	45
(cole)	(2)	10. cool	AA 1000
9. cup*	AA 1000	11. dig*	43
10. dawn	A	12. door	AA 500
11. dim	37	13. dull*	48
12. dock	16	14. fan*	38
13. five*	AA 500	15. fire	AA 500
14. food*	AA 500	16. get*	AA 500
15. gaze	A	17. gone	AA 500
16. good*	AA 500	18. hike*	10
17. half	AA 500	19. hiss*	16
18. hot*	AA 1000	20. howl*	34
19. hush*	26	21. jam*	16
20. juice	37	22. jot [dʒat]	3
21. knit*	30	23. knock	A
22. lean	A	24. lawn	37
23. light	AA 500	25. live [lɪv]	AA 500

EXHIBIT 4 (Continued).

CNC List 5		CNC List 6	
Word	Frequency	Word	Frequency
24. limb	38	26. look*	AA 500
25. luck	46	27. map*	A
26. match	A	28. mode*	23
27. mean	AA 500	(mowed)	(6)
28. myth*	8	29. move*	AA 500
29. nag*	5	30. niece*	10
30. nudge*	2	31. night*	AA 500
31. peg*	9	(knight)	(AA 1000)
32. pull	AA 1000	32. pace	A
33. purse*	38	33. pole	A
34. raid*	11	(poll)	(17)
35. robe*	31	34. pope	26
36. rough*	A	35. raise*	AA 1000
(ruff)	(1)	(raze)	(2)
37. sail	AA 1000	(rays)	(A)
(saie)	(A)	36. rug*	40
38. shop*	AA 1000	37. rush*	AA 1000
39. sing	AA 1000	38. search	A
40. sore*	38	39. shock*	A
41. tease	14	40. shone	34
(teas)	(A)	41. sit*	AA 1000
42. tell*	AA 500	42. sour*	15
43. then*	AA 500	43. team	A
44. thought	AA 500	(teem)	(6)
45. town	AA 500	44. tube*	32
46. veil	30	45. turn*	AA 500
(vale)	(13)	46. veal	5
(vail)	(1)	47. web*	14
47. wire*	A	48. whip [wɪp]	41
48. worm	37	49. wife*	AA 500
49. yoke	13	50. wing	AA 1000
(yolk)	(3)		
50. zeal	15		

CNC List 7		CNC List 8	
Word	Frequency	Word	Frequency
1. bet*	23	1. bag	AA 1000
2. big*	AA 500	2. bath*	46
3. bun	4	3. bite	33
4. call	AA 500	4. calm	A
5. caught	AA 1000	5. cheap*	A
6. cheek	A	6. cough	18
7. coke	5	7. cub*	11
8. did*	AA	8. daze	12
9. doom	20	(days)	(AA 500)
10. dumb*	34	9. den	23
11. face	AA 500	10. dive*	21
12. far*	AA 500	11. foam*	21

EXHIBIT 4 (Continued).

CNC List 7		CNC List 8	
Word	Frequency	Word	Frequency
13. fish	AA 1000	12. fuss*	11
14. geese	26	13. gag	3
15. gem*	24	14. gear	9
16. gun*	A	15. gin*	9
17. have*	AA 500	16. guide	AA 1000
(halve)	(2)	17. hail	40
18. heat*	AA 1000	(hale)	(7)
19. hole*	AA 1000	18. hoop	8
(whole)	(AA 500)	(whoop)	(7)
20. join	AA 1000	19. hurl*	20
21. laugh*	AA 500	20. jerk	18
22. led*	AA 1000	21. lash*	22
23. loot	3	22. learn	AA 500
24. lose*	AA 1000	23. loathe	7
25. mine	AA 1000	24. lock	A
26. mole	14	25. moss	22
27. mouth*	AA 1000	26. muff*	5
28. nap*	15	27. near	AA 500
29. neck*	AA 1000	28. noose*	2
30. note*	AA 500	29. page*	AA 1000
31. pass*	AA 500	30. poor	AA 500
32. pearl*	47	31. pose	10
33. pine	A	32. rain	AA 1000
34. reach*	AA 500	(reign)	(44)
35. rib*	31	33. real*	AA 500
36. ridge*	31	(reel)	(19)
37. sack*	30	34. road*	AA 500
(sac)	(1)	(rode)	(A)
38. save	AA 1000	(rowed)	(A)
39. shall	AA 500	35. rot*	8
40. side*	AA 500	36. sad	A
(sighed)	(A)	37. seek	AA 1000
41. such*	AA 500	38. shawl	9
42. sure	AA 500	39. shoot	A
43. tape	8	40. some	AA 500
44. tar	10	41. there*	AA 500
45. third	AA 1000	(their)	(AA 500)
46. top	AA 1000	42. thing	AA 500
47. vague*	20	43. tin	36
48. was	AA 500	44. tip*	A
49. wit	A	45. touch*	AA 1000
50. young	AA 500	46. vowel	5
		47. wake*	A
		48. week*	AA 500
		(weak)	(A)
		49. wet	A
		50. wheat* [mit]	A

## EXHIBIT 4 (Continued).

CNC List 9		CNC List 10	
Word	Frequency	Word	Frequency
1. ball*	AA 1000	1. bake	A
(bawl)	(6)	2. bit*	AA 1000
2. beat	AA 1000	3. burn	AA 1000
(beet)	(11)	4. cause	AA 500
3. book*	AA 500	(caws)	(4)
4. both	AA 500	5. cave*	33
5. catch*	AA 1000	6. chat*	12
6. chair*	AA 1000	7. chill*	43
7. cheer	A	8. coin	A
8. curve*	36	9. cone	7
9. cut*	AA 500	10. death*	AA 1000
10. deck*	A	11. deep*	AA 1000
11. dish*	A	12. din*	11
12. dog*	AA 1000	13. fine*	AA 500
13. feet*	AA 500	14. fool*	AA 1000
(feat)	(13)	15. gore	7
14. fudge*	1	16. guess*	AA 1000
15. girl	AA 500	17. hair	AA 1000
16. got*	AA 500	(hare)	(18)
17. ham	17	18. hit*	A
18. haze	5	19. hurt*	AA 1000
(hays)	(46)	20. jade*	4
19. hen	49	21. judge*	AA 1000
20. jazz*	5	22. load	A
21. lack	A	(lode)	(1)
22. lathe*	2	23. loose*	A
23. lip*	AA 1000	24. lot	AA 1000
24. loaf	17	25. lung	15
25. mire	7	26. meek	7
26. mob	20	27. mood*	27
27. mud*	47	28. mouse	34
28. nail	A	29. neat*	29
29. need*	AA 500	30. nick*	5
(knead)	(5)	31. palm	37
30. pill	7	32. path*	AA
31. power	AA 500	33. peak	28
32. pun*	1	(peek)	(3)
33. rag*	28	34. pile*	A
34. reap*	14	35. ride*	AA 1000
35. roof [ruf]	AA	36. rob*	41
36. sane	11	37. rope*	A
37. shade*	AA 1000	38. run	AA 500
38. shout*	AA 1000	39. safe	AA 1000
39. sin*	A	40. sag*	5
40. soap*	37	41. sell*	AA 1000
41. thine*	19	42. shack*	7
42. time*	AA 500	43. sub	1
43. tick*	12	44. term	A

EXHIBIT 4 (Continued).

CNC List 9		CNC List 10	
Word	Frequency	Word	Frequency
44. tool	40	45. thatch	6
45. voice	AA 500	46. towel	18
46. watch*	AA 500	47. wash* [wɔʃ]	AA
47. white* [waɪt]	AA 500	48. while [waɪl]	AA 500
48. word	AA 500	49. witch	24
49. wrong	AA 500	50. your [jʊr]	AA 500
50. yes*	AA 500		

\*Also included in PB lists.

EXHIBIT 5: TILLMAN AND CARHART NORTHWESTERN  
UNIVERSITY AUDITORY TEST 6.

List I		List II	
1. BEAN	26. MET	1. BITE	26. MERGE
2. BOAT	27. MODE	2. BOOK	27. MILL
3. BURN	28. MOON	3. BOUGHT	28. NICE
4. CHALK	29. NAG	4. CALM	29. NUMB
5. CHOICE	30. PAGE	5. CHAIR	30. PAD
6. DEATH	31. POOL	6. CHIEF	31. PICK
7. DIME	32. PUFF	7. DAB	32. PIKE
8. DOOR	33. RAG	8. DEAD	33. RAIN
9. FALL	34. RAID	9. DEEP	34. READ
10. FAT	35. RAISE	10. FAIL	35. ROOM
11. GAP	36. REACH	11. FAR	36. ROT
12. GOOSE	37. SELL	12. GAZE	37. SAID
13. HASH	38. SHOUT	13. GIN	38. SHACK
14. HOME	39. SIZE	14. GOAL	39. SHAWL
15. HURL	40. SUB	15. HATE	40. SOAP
16. JAIL	41. SURE	16. HAZE	41. SOUTH
17. JAR	42. TAKE	17. HUSH	42. THOUGHT
18. KEEN	43. THIRD	18. JUICE	43. TON
19. KING	44. TIP	19. KEEP	44. TOOK
20. KITE	45. TOUGH	20. KEG	45. TURN
21. KNOCK	46. VINE	21. LEARN	46. VOICE
22. LAUD	47. WEEK	22. LIVE	47. WAG
23. LIMB	48. WHICH	23. LOAF	48. WHITE
24. LOT	49. WHIP	24. LORE	49. WITCH
25. LOVE	50. YES	25. MATCH	50. YOUNG

### EXHIBIT 5 (Continued).

List III		List IV	
1. BAR	26. HOUSE	1. BACK	26. MOB
2. BASE	27. NAME	2. BATH	27. HOOD
3. BEG	28. NOTE	3. BONE	28. NEAR
4. CAB	29. PAIN	4. CAME	29. NEAT
5. CAUSE	30. PEARL	5. CHAIN	30. PASS
6. CHAT	31. PHONE	6. CHECK	31. PEG
7. CHEEK	32. POLE	7. DIP	32. PERCH
8. COOL	33. RAT	8. DOG	33. FAD
9. DATE	34. RINC	9. DOLL	34. RIPE
10. DITCH	35. ROAD	10. FIT	35. ROSE
11. DODGE	36. RUSH	11. FOOD	36. ROUGH
12. FIVE	37. SEARCH	12. GAS	37. SAIL
13. GERM	38. SEIZE	13. GET	38. SHIRT
14. GOOD	39. SHALL	14. HALL	39. SHOULD
15. GUN	40. SHEEP	15. HAVE	40. SOUR
16. HALF	41. SOUP	16. HOLE	41. SUCH
17. HIRE	42. TALK	17. JOIN	42. TAPE
18. HIT	43. TEAM	18. JUDGE	43. THUMB
19. JUG	44. TELL	19. KICK	44. TIME
20. LATE	45. THIN	20. KILL	45. TIRE
21. L'D	46. VOID	21. LEAN	46. VOTE
22. LIFE	47. WALK	22. LEASE	47. WASH
23. LUCK	48. WHEN	23. LONG	48. WHEAT
24. MESS	49. WIRE	24. LOSE	49. WIFE
25. MOP	50. YOUTH	25. MAKE	50. YEARN

### NUMBER OF RESPONSE ALTERNATIVES

Another factor affecting the quantitative intelligibility score is the number of response alternatives. As far as word tests are concerned, the first practical multiple-choice answer sheet test was developed by Haagen (1946) and used extensively at the Navy Electronics Laboratory in applied studies on competing messages (in air control towers), see Webster and Thompson (1954). These tests were updated and used extensively by Black, Tolhurst, and Morrell (1953) and Black (1957) at the USN School of Aviation Medicine. Black's list and the answer sheet foils are shown in exhibit 6.

In these tests the talker is given a list of words to read and the listeners mark prepared blanks on which each word read appears as one of four similar words. The listeners require no special training: the talker reads three words, then pauses 2 seconds, allowing time for the listener to respond. This is a relatively short-duration test of about 1 minute for 27 words. It is not phonetically balanced.

Extensively used phonetically-balanced, limited-choice, answer-sheet tests have been developed by Fairbanks (1958), House et al (1965), and Kreul et al (1968). Exhibits 7 and 8 show the 250 Fairbanks (1958) words, an answer sheet, and the methods used to construct talker lists and randomization. In general, there is a one-out-of-five chance of guessing the

# EXHIBIT 6: BLACK'S MULTIPLE-CHOICE WORD TESTS

Speaker 1 is _____		
1	groove drew* crew grew	modern moderate modesty* modest
2	say stay stayed* spade	forbade pervade surveyed survey*
3	stung stun sun stunned*	chink kink* check chin
4	quench went whence when*	drunk gunt bunt runt*
5	pass past* cast task	intend content intense*
6	popular poplar hopper* opera	trade* waves wave way
7	immense commence emit cement*	fin find* sign kind
8	latter ladder* lattice rabbit	named name main* knaves
9	crash crab craft crack*	only woman* omen swain*

Speaker 2 is _____		
1	ninety nineten nighty* nine	drum rung rum* run
2	ran rank rang* rag	harrow peril herald* arrow
3	lick tick* pick hick	need lead lean leave*
4	shower scholar sour* scour	see* seed siege seize
5	berry carry bearing* very	depot people equal* decoy
6	mouse mouth now mount*	carthen earthly urban* bourbon
7	quarter fortress portrait porter*	bath bat* bad back
8	heavy happen* package happy	listless mistress* stless blissful
9	hamper pamper panther* pamphlet	spring pray spray spread

Speaker 3 is _____		
1	apply supply amply* fly	gift* if hit it
2	bust fuss* but bus	lamp lace glance* land
3	air hairy* arid carry	handle* anvil amble ample
4	throw froze prose probe*	free freeze freed tree*
5	desk depth dead death*	fed stead* spend sped
6	broke growth* throat write	rod* brown loathsome lonesome*
7	sister system* cistern pistol	science stand* stamp spent
8	strike spite fight* spike	code told cold coal*
9	paid page* age haze	begin* begot forgot deduct

Speaker 4 is _____		
1	much mud month monk*	uplift uproot* approve group
2	twelve well* dwell weld	cypress cipher siphon sightless*
3	wren went rent lent*	mind* mild mine line
4	guide die died* dive	blister blissful listful* wistful
5	stove sold stole soul*	barter barker sparkle parker*
6	reverse traverse* perverse pervert	found crown* cloud clown
7	drove stroke* strode strove	love* lull low lag
8	fire hire* tired tire	equipped acquit equip* quit
9	gaily fall daily* five	simple dimple pimple* temple

Speaker 5 is _____		
1	crash drag trash thrash*	least lease niece* leaf
2	pillow pillar killer* filler	wouldn't wood wooden wooded*
3	lava loud lock robber*	peg keg egg pay*
4	glad lad laugh lag*	loosely gruesome loosen nuisance*
5	puncture teacher tincture picture*	hour how howl* owl
6	tempt tense lent hemp*	part art heart arch*
7	youth you use mute*	bake bait* fate faith
8	tight* pike height hike	seller solemn* solid sullen
9	devise defy divide beside*	muster lusty bluster* luster

Speaker 6 is _____		
1	feel deal steal veal*	fruit* true troop truth
2	tasty hasty hasten pastry*	pelvis* elder elbow eldest
3	wrist* risk rip list	add ask as has*
4	shoe choose too* chew	depth* death deal guest
5	led red ledge leg	fortune fort* important forty
6	butter flutter flood flattered*	defense methinks repent bethinks*
7	thumb from* come sum	hamper tamper hampered* hamburg
8	bower borrow flower* power	stow stole stowed* stove
9	deceive precede concede* receive	tick chicken* ticket picket

Correct responses (items) are underlined and the items of alternate lists are designated by asterisks.

# EXHIBIT 6 (Continued).

Speaker 7 is		
1	providence problem promise province*	worse work worst worth*
2	row throw grove* grow	pledge* sied sledge sleigh
3	suffer zipper supper* zephyr	wearing* wearer wary wear
4	bathe save* space spade	stomach staunch stark starch*
5	depth deck death* debt	scram swing slam* swam
6	attend* akin attempt again	grandsire grandstand transpire* grandchild
7	break rate* rape rake	reverse invert* divert revert
8	tack tax facts* tact	anew unused* amuse unuse
9	anew balloon aloof* allude	bristle brittle nipple riddle*

Speaker 8 is		
1	eighty acre aching* eight	trump* front truck trunk
2	delude remove elude renew*	irk* hurt earth heard
3	can't scant scamp scan*	gauge gaze gave gay*
4	find bind vine* fine	flatter* climate planet plant
5	dumb gum* dump done	fitness thickness sickness* picnic
6	snout smelt* snub snap	royal broil broiled* boil
7	stead dead sped* bed	afford* abhor accord afore
8	white poison hoist voice*	bury barely fairly fairy*
9	next* nets mix neck	error errand barren Arab*

Speaker 9 is		
1	bite bike vice fight*	abhor applause applaud apply*
2	apace attain face aface*	pulse faul pulp false*
3	bruise brood brew* cruise	goose noose use deuce*
4	bramble scramble gravel* ramble	rather letter lever* leather
5	stain stink sting sing*	hence tense tent hint*
6	groom prune broom room*	train* crane brain frame
7	handsome cancer* camphor cancel	listen christen Christmas prison*
8	suit soon* soothe sue	parcel hardly partly* parsley
9	steam seen speed esteem*	neither* meter meager leader

Speaker 10 is		
1	artist harness* harvest orchid	vesper* fester pester festive
2	simple sinful summon stomach*	knoll known no mold*
3	litter littie glitter* liquor	Boston bound bond barn*
4	main* mink make mate	cross wrestle rascal rapture raffle*
5	lengthen ointment Lincoln* link	popo hope oak post*
6	bud bus* bust but	march margin marching Martin*
7	pleasant pheasant peasant* present	rain* wing green ring
8	winter* winner where woman	hearing hairly* carry herring
9	lose* loose loot blue	twelfth twelfth Martin*

Speaker 11 is		
1	toward forge ford board*	feeling dealer* fever feeler
2	destroy* deprive defraud defrost	dome don't* zone stone
3	chart* short shark sharp	girl pearl curled* curl
4	native navy* naked nature	flicker clipper liquor quicker*
5	latho lay laid* leg	sultry culprit sculpture* sculptor
6	thus bust duck dust*	pearl calf cad* calves cab
7	bulb bulge bald* ball	ink pinch inch hint*
8	breast friend* breath bread	hit fist this* kiss
9	harbor harder ardor artist*	cut carpet cotton copper*

Speaker 12 is		
1	needle evil meal* neither	large lodge lie live*
2	dimple gentle devil* dental	haven* heaven even able
3	armload armholed armhole armful	cast past pass* path
4	gem gent gin gym*	pen* woody wood witty
5	flush pledge fresh flesh*	creeping greeting* greedy reading
6	auburn often author* autumn	waitful* wake wasteful wakeful
7	nest russ meant* met	astride ascribe prescribe describe*
8	gram raise raid rage*	harrow* herald arr w peril
9	flapper leopard leper* letter	nuptial* nocturnal nutshell neptune

# EXHIBIT 6 (Continued).

Speaker 13 is		
1	virtue merchant virgin burden	blend land when* lend
2	birth first verse burst*	casual passion peasant* pageant
3	wench quench clinch* went	caught pot* hot fox
4	pious highest bins* higher	beat* beef eat deep
5	deface* debate base debate	bridle* vital rifle Bible
6	flare fire fighter* player	pose hose cold hold
7	stun stung sun sung*	peppy* heavy petty penny
8	frankness Franklin practice* frankly	foil boil toil coil
9	craze phrase* praise pray	limit women lunch lemon
		bring* break brink drink call* is palace pilot palate third* thoroughly heard bird

Speaker 14 is		
1	mouse mountain mount mouth*	drink bring brink spring*
2	quarter porter order* border	dove dope dough dull*
3	dull gulf gull* dog	detect effect deflect defect*
4	effect infect inspect confess*	goat scope spoke* stake
5	root group droop* roof	wash watch why walk*
6	shell chow shall* child	try cry fry pry*
7	sudden sun seven southern*	front* punch punt hunt
8	cuss put pus* push	green dream* greed* grieve
9	talk toss taught* hat	happy after happily athletic*
		towel* Holland tallow hallow cook approach croak* broke hinge* tinge pin king hash* add ask ash doubtless* thoughtless dauntless darkness staple* fable stable spacious cauze cause* guard dog razor raisin* reason brazen repress depress* regret request

Speaker 15 is		
1	urge heard purge courage*	envy* engine ending pending
2	scallop scholar scout gallop*	gild* fill hill ill
3	bless* less left last	often author auto offer*
4	bridge rich* ridge rig	downing* doubt downy down
5	even beacon* deacon deepen	fear beer beard dear*
6	settle subtle settled* seven	list hisp left* lip
7	hung hum tongue* come	listful* wistful whisper wishful
8	meager maker meter eager*	kill till fill pil
9	caught talk taught trough*	bring grim* brim grim
		cobweb cobbler problem copper* fog five bog by* perish parent carrot* parrot grace brake brace great* deluge elude delude* village gallon* gallop galley gallant day* bay days bathe brook rook cook roof repute refuse refute compute

Speaker 16 is		
1	decides besides beside decide*	hate taste hast* paste*
2	spinach clinic senate* cynic	all fog goes* hall
3	litter lizard whether blizzard*	fat back spat slack*
4	in hinge pin king*	rubbish radish reddish ready*
5	scared* secret safety sacred	aid aim paid age*
6	plant slam slant plan*	Farley* barley parley Farley
7	passing after* apple acid	foundry founder* founder flounder
8	content contest contact convent*	Dick dig fig big*
9	cause poise pause* car	atom abbot habit avid*
		pamper tamper* hamper pamphlet dozed dove goes* doze mouth moss moth* malt hate take cake* intake lava* Florida lava larger cloth* fall flog flaw crawled craw frog crawl rapid rattle wrapper grapple toward torn tore board

Speaker 17 is		
1	lurch* work lurk albeit	faces* baker basic basis
2	sought* sock sun stop	muster rustic rusty* rustle
3	only olden older* golden	horn corn form* thorn
4	island highland pilot pylon*	flange plan clam planned
5	bondage abandon bandit bandit*	ten* pen pin pinned
6	cat hat cap* catch	line* lying flying lion
7	rim brim grim* grim*	gobble goblet goggle* gobbled
8	bed did* dead bid	spill still spilled* fill
9	mail maiden neighbor maybe*	earl pearl burrow* girl
		shuffle shudder* shutter shuttle hard card faired* car fruit* root brute group shelf shout shelve shell blimp blink bleak link theft heck peck pet* cleft theft* crept slept counting* bounty country county horn torn thorn* corn

Speaker 18 is		
1	summer summon summit summon*	man mass mas* mac*
2	lighter* spider fighter piker	roller rolling roll rear*
3	verbal bunble gurgle purple	breeze* greed breathe grieve
4	fried try tribe* tried	plus flood bust pluck
5	we read weed weave	retold refold threefold repose*
6	sofa soap silver sober*	hate cape* cake case
7	lung* love drunk lump	hurt turn turf Turk*
8	shilling chilling* chilly killing	falcon* pulpit culprit poker
9	gag gad gas gab	nap nest mess net*
		bun fun front fund none mountain now numb eat heat feet peak child childish childless* childhood guess guest gas get best bet desk theft pardon* hardly harden hard mark* mock lock mop allow aloft lock allot*

# EXHIBIT 6 (Continued)

Speaker 19 is		
1	pleasing* easy fleece sleepy	wolf wolves* wore wool
2	yule fuel* new mule	chap* chaff chal check
3	field deal heel* feel	hem hemp pen* hemmed
4	farm harm paw arm*	woodland* curse wooden hearse* wouldn't purse woodman perch
5	mouthful mirthful Myrtle beautiful	tighten type tight* title
6	shaky shady shade shaving*	lip lick lift* lit
7	raw drawl drawl draw*	glow blow slow flow*
8	hairy fairy carriage carry*	enjoying* enjoyment enjoy
9	soothe sue suit soon*	paid hey* pay key
	whence glimpse bliss blimp*	sweep* sweeten sweet sweetened

Speaker 20 is		
1	scout spouse hout* spout	weed* weave reed leave
2	reedy meeting easy need*	rider* lighter writer writing
3	pick detect depict eclipse*	put* foot book cook
4	fold* cold hold hole	clean please plead* flea
5	brazen break great raisin*	naive* name maid nave
6	hot not* pet plot	logic* logging lodging Roger
7	mission* vision fisher bishop	string* strain strange drain
8	soft sought sauce saw*	brought broad iron drought*
9	fill built guild* bill	tenant* penance pennant tennis
	defile file defy* devise	doomed* dune do doom
		court courts* corpse torch
		wreck wrench wretch* rest

Speaker 21 is		
1	far* barn farm arm	want one wanton wanted*
2	unstained insane unseen unstain*	late* like light right
3	vowel bow vow* valve	dog dull gull doll*
4	spouse astound espouse espoused*	hammer hemlock* cannon hammock
5	tongue hung hum ten*	elf* held elm elves
6	wet* west wept weapon	platter planter planted lantern*
7	author offer often* office	cost cross frost* fraud
8	prune crude true prove*	tail called call* solve
9	fuse feud hue few*	time ton come* tongue
		icing icy ice item
		vest best* theft desk
		thought box fox fought*
		mouth* month mumps monk
		reduce review refute* rebuke
		saved save say sage*

Speaker 22 is		
1	jig gate dig* gig	right brighten frighten* bright
2	safer savor favor* saber	lay* blade blaze glaze
3	decay debate efface* deface	worn one* wand blend
4	wool woe wove* low	lick lift* lip
5	plain playmate plainly* plainness	gross growth group broke*
6	rigid bridges* frigid tribute	smile smart smock* mock*
7	mortar marble* mortal morbid	blast* glad glass black
8	does bud* buzz bug	village visit* busy vivid
9	lesson glisten* blessing blessed	gold go dull dough*
		bit fit* disc dip
		press crest* pressed
		resort* export absorb exhort

Speaker 23 is		
1	long round loud lounge*	ask act hat ax*
2	puzzle huddle cuddle* puddle	vulture bolster* also vulgar
3	ounce out house* bounce	able nice table fable* cable
4	omit commit* commence permit	bless less* bled blessed
5	tiny kindly hang timing*	jade* jail jaz jig
6	purpose propose oppose suppose*	earthly virtue virgin* urgent
7	frighten brightness greatness breakfast* dive*	blunder* plunger plunder thunder
8	bland land* plan gland	keeper caper faper* paper
9	flack* flat black blast	tremble* several trouble treble
	hem* hand end hen	smithy* Smitty smitten Smith
	gave* gain gave gay	merit match marriage* marry

Speaker 24 is		
1	wax waxing* waxy waxen	herb hurt urge heard*
2	home roam own old*	glance glass gland glands*
3	screen free* spree spring	speaker teacher feature Beecher*
4	length* link leak blink	and end an hand*
5	yea gave gale gay*	lying* line lion lining
6	follow folly bother* father	love* log lost loud
7	intrude confess improve* intrigue	bank thank sank* think
8	loss* block lost gloss	whiskey trip drifting* thrifty
9	grip* drift rip drip	basin basen basement* basic
		stuffed stuff stop stuck*
		brought* wrought rock rocked
		paint nk pink peak*
		stomach* summon summit summer
		frock crook crop prop

EXHIBIT 7: FAIRBANKS' RHYME TEST (FIVE SETS OF 50 RHYMING WORDS).

1. BACK	51. FED	101. LAW	151. PAST	201. SOD
2. BALE	52. FEEL	102. LED	152. PAW	202. SOIL
3. BANG	53. FELL	103. LEND	153. PAY	203. SOLD
4. BARK	54. FIG	104. LET	154. PEEL	204. SOON
5. BEAT	55. FIGHT	105. LICK	155. PEN	205. SORE
6. BED	56. FILE	106. LIGHT	156. PICK	206. SUCK
7. BELL	57. FILL	107. LINK	157. PIG	207. SUN
8. BEND	58. FINE	108. LINE	158. PILE	208. TAIL
9. BENT	59. FIRE	109. LIP	159. PIN	209. TAKE
10. BEST	60. FIT	110. LOCK	160. PINK	210. TALE
11. BID	61. FOIL	111. LOOK	161. POP	211. TELL
12. BIG	62. FUN	112. LOT	162. POT	212. TEN
13. BILL	63. GAIN	113. LUCK	163. PUMP	213. TEND
14. BIT	64. GAME	114. LUMP	164. RAGE	214. TENT
15. BOIL	65. GANG	115. MAIL	165. RAIN	215. TEST
16. BOOK	66. GATE	116. MAIN	166. RANG	216. TICK
17. BOON	67. GET	117. MAKE	167. RATE	217. TIDE
18. BORE	68. GOD	118. MALE	168. RAW	218. TILE
19. BORN	69. GOLD	119. MARK	169. RED	219. TILL
20. BUCK	70. GOT	120. MAST	170. REEL	220. TIN
21. BUMP	71. GUN	121. MAY	171. RENT	221. TIP
22. BUST	72. HANG	122. MEAL	172. REST	222. TIRE
23. CAGE	73. HATE	123. MEAT	173. RID	223. TOIL
24. CAKE	74. HEAL	124. MEN	174. RIDE	224. TOLD
25. CAME	75. HEAT	125. MEND	175. RIGHT	225. TOOK
26. CAST	76. HEEL	126. MET	176. RIP	226. TOP
27. COCK	77. HEN	127. MIGHT	177. ROCK	227. TORE
28. COD	78. HID	128. MILE	178. ROD	228. TORN
29. COIL	79. HIDE	129. MINK	179. RUN	229. TUCK
30. COLD	80. HIP	130. MINE	180. RUST	230. VAIN
31. COOK	81. HIRE	131. MOCK	181. SACK	231. VILE
32. COON	82. HIT	132. MOON	182. SAGE	232. WAGE
33. COP	83. HOLD	133. MOP	183. SAIL	233. WAKE
34. CORN	84. HOOK	134. MORE	184. SALE	234. WAY
35. DARK	85. HOP	135. MUST	185. SAME	235. WED
36. DATE	86. HORN	136. NAIL	186. SANG	236. WELL
37. DAY	87. HOT	137. NAME	187. SAW	237. WENT
38. DEAL	88. JACK	138. NEAT	188. SAY	238. WEST
39. DEN	89. JAW	139. NEST	189. SEAL	239. WIDE
40. DID	90. JUMP	140. NIGHT	190. SEAT	240. WIG
41. DIG	91. JUST	141. NINE	191. SELL	241. WILL
42. DIN	92. KEEL	142. NOD	192. SEND	242. WIN
43. DIP	93. KICK	143. NOON	193. SENT	243. WINK
44. DOCK	94. KID	144. NOT	194. SET	244. WINE
45. DUCK	95. KILL	145. NUN	195. SICK	245. WIRE
46. DUMP	96. LACK	146. PACK	196. SIDE	246. WIT
47. DUST	97. LAKE	147. PAGE	197. SIN	247. WORE
48. FAIL	98. LARK	148. PAIN	198. SINK	248. WORN
49. FAME	99. LAST	149. PALE	199. SIRE	249. YET
50. FAST	100. LATE	150. PARK	200. SIT	250. ZEAL

**EXHIBIT 8: FAIRBANKS' RHYME TEST ANSWER SHEET  
AND RANDOMIZATION OF INITIAL CONSONANTS  
FOR EACH OF THE FIVE LISTS**

NAME: _____			
DATE: _____			
TEST No. _____			
1. _____	ot	h,g,n,p,l	26. _____
2. _____	ay	p,m,d,w,s	27. _____
3. _____	op	t,h,p,m,c	28. _____
4. _____	eel	p,r,f,h,k	29. _____
5. _____	ake	w,t,m,c,l	30. _____
6. _____	aw	l,s,j,p,r	31. _____
7. _____	ile	v,m,f,t,p	32. _____
8. _____	eat	n,s,b,h,m	33. _____
9. _____	ook	l,c,h,t,b	34. _____
10. _____	ill	f,k,w,t,b	35. _____
11. _____	ire	t,h,s,f,v	36. _____
12. _____	ale	m,t,s,p,b	37. _____
13. _____	ent	s,r,w,b,t	38. _____
14. _____	oon	m,n,c,b,s	39. _____
15. _____	ick	k,s,l,t,p	40. _____
16. _____	ame	s,f,n,c,g	41. _____
17. _____	ide	w,t,s,r,h	42. _____
18. _____	ip	r,d,l,h,t	43. _____
19. _____	ore	s,b,t,m,w	44. _____
20. _____	ang	b,h,s,g,r	45. _____
21. _____	on	m,d,h,p,t	46. _____
22. _____	ark	p,b,l,m,d	47. _____
23. _____	oil	c,f,b,s,t	48. _____
24. _____	ig	b,w,d,f,p	49. _____
25. _____	age	r,c,p,s,w	50. _____
	ast	c,p,f,l,m	
	ain	g,p,m,r,v	
	est	n,w,t,b,r	
	un	g,n,r,s,f	
	eal	h,d,s,z,m	
	in	s,w,t,d,p	
	ust	b,j,m,r,d	
	ine	f,m,w,n,l	
	ink	m,l,p,w,s	
	old	s,t,h,c,g	
	it	h,s,w,f,b	
	ed	l,b,r,w,f	
	end	t,s,b,l,m	
	id	r,b,k,d,h	
	ack	b,l,p,j,s	
	ail	t,s,m,n,f	
	ight	f,l,r,m,n	
	orn	t,w,b,h,c	
	od	r,g,c,s,n	
	ock	d,m,c,l,r	
	ump	b,p,l,d,j	
	ate	d,r,g,l,h	
	ell	w,f,t,b,s	
	et	s,l,g,y,m	
	uck	l,t,d,s,b	

correct word, but the number of possible words can range as high as nine. For example, although only got, hot, lot, not, and pot are actually used, a listener might think of jot, rot, sot, or tot. This test was used extensively at the Naval Electronics Laboratory Center in studies of the speech interfering effects of navy noises; see Webster and Klumpp (1965).

A criticism of the Fairbanks Rhyme Test is that it tests initial consonants only (and the response set varies from five to nine). House et al (1965) and Kreul et al (1968) took care of both of these flaws by making a six-alternative-answer sheet foil and testing for initial and final consonants, see exhibits 9 and 10.

The Kreul et al (1968) tests are easy to administer, require no training, and are relatively fast to complete—about 90 seconds for 50 words, since only a 1.5-second interval is required between words. The Kreul is the preferred test at NELC now. The word score equivalency between it, the Fairbanks test, and PB words can be found in figure 12. Webster and Allen (1972), simplified and reproduced as figure 2.

**EXHIBIT 9: KREUL ET AL AND HOUSE ET AL MODIFIED RHYME TESTS (MRT)  
(SIX SETS OF 50 RHYMING WORDS).**

1. BACK	61. DULL(-)	118. LANE	176. POT	233. SUB
2. BAD	62. DUN	119. LARK	177. PUB	234. SUD
3. BALE	---(DUNG)	120. LATE	---(PUCK)	235. SUM
4. BAN	63. DUST	121. LAW	178. PUFF	236. (2)SUN
5. BANG	64. EEL	122. LAY	179. PUG(-)	237. SUNG
6. BARK	65. FAME	123. LED	180. PUN	238. SUP
7. BASS	66. FANG	124. LICK	181. PUP	239. TAB
8. BAT	67. FEAT	125. LIP	---(PUS)	240. TACK
9. BATH	68. FED	126. LOOK	187. PUTT(-)	241. TALE
10. BEACH	69. FEEL	127. LOT	183. RACE	242. TAM
11. BEAD	70. FIB	128. MAD	184. RAKE	243. TAME
12. BEAK	71. (2)FIG	129. MALE	185. RANG	244. TAN
13. BEAM	72. (2)FILL	130. MAN	186. RATE	245. TANG
14. BEAN	73. (2)FIN	131. MAP	187. RAVE	246. TAP
15. (2)BEAT	74. (2)FIT	132. MARK	188. RAW	247. TEACH
16. BED	75. FIZZ	133. MASS	189. RAY	248. TEAK
17. BENT	76. FOIL	134. MAT	190. RAZE	249. TEAL
18. BEST	77. FOLD	135. MATH	191. RED	250. TEAM
19. BIG	78. FUN	136. MAY	192. REEL	251. TEAR
20. BILL	79. GALE	137. MEAT	193. RENT	252. TEASE
21. BIT	80. GAME	138. MEN	194. REST	253. TEN
22. BOIL	81. GANG	139. MOP	195. RIG	254. TENT
23. BOOK	82. GAY	140. MUST	196. RIP	255. TEST
24. BUCK	83. GOLD	141. NAME	197. RUN	256. THAW
25. BUFF	84. GOT	142. NEAT	198. RUST	257. THEN
26. BUG	85. GUN	143. NEST	199. SACK	258. TICK
27. (2)BUN	86. GUST	144. NOT	200. SAD	259. TILL
28. BUS	87. HANG	145. NUN	201. SAFE	260. TIN
29. BUST	88. HARK	146. OIL	202. SAG	261. TIP
30. BUT	89. HEAL	147. PACE	203. SAKE	262. TOIL
31. CAKE	90. HEAP	---(PACK)	204. (2)SALE	263. TOLD
32. (2)CAME	91. HEAR	148. PAD	205. (2)SAME	264. TOOK
33. CANE	92. (2)HEAT	149. PAGE	206. SANE	265. TOP
34. CAPE	93. HEATH	150. (2)PALE	207. SANG	266. TOT
35. CASE	94. HEAVE	151. PAN	208. SAP	267. VEST
36. CAVE	95. HEEL	152. PANG(-)	209. SASS	268. WAY
37. COIL	96. HEN	153. PANE	210. SAT	269. WED
38. COLD	97. HILL	154. PARK	211. SAVE	270. WENT
39. COOK	98. HIP	155. PASS	212. SAW	271. WEST
40. COP	99. HIT	156. PAT	213. SAY	272. WICK
41. CUB	100. HOLD	157. PATH	214. SEAT	273. WIG
42. CUD	101. HOOK	158. PAVE	215. SEED	274. WILL
43. CUFF	102. HOP	159. PAW	216. SEEK	275. WIN
44. CUP	103. HOT	160. (2)PAY	217. SEEM	276. WIT
45. CUSS	104. JAW	161. PEACE	218. SEEN	
46. CUT	105. JIG(-)	162. PEACH	219. SEEP	
47. DARK	106. JUST	163. PEAK	220. SEETHE	
48. DAY	107. KEEL	164. PEAL	221. SENT	
49. DEN	108. KICK(KICK) (2)	165. PEAS	222. SHED	
50. DENT	109. KID	166. PEAT	223. SHOOK	
51. DID	110. (2)KILL	167. PEEL	224. SHOP	
52. DIG(DIG) (2)	---(KIN)	168. PEN	225. (2)SICK	
53. DILL	111. KING	169. (2)PICK	226. SILL	
54. DIM	112. KISS(-)	170. (2)PIG	227. (2)SIN	
55. (2)DIN	113. (2)KIT	171. PILL	228. SING	
56. (2)DIP	114. KITH(-)	172. (2)PIN	229. (2)SIP	
57. DUB	115. LACE	173. PIP	230. (2)SIT	
58. DUCK	116. LAKE	174. PIT	231. SOIL	
59. DUD	117. LAME	175. POP	232. SOLD	
60. DUG				

Notes. The numeral 2 in parentheses signifies that the word is used twice in the test.

The words in parentheses are those used by House et al and not by Kreul et al.

# EXHIBIT 10: KREUL ET AL MODIFIED RHYME TEST ANSWER SHEETS.

NAME \_\_\_\_\_ EAR \_\_\_\_\_ DATE \_\_\_\_\_

MODIFIED RHYME HEARING TEST 1 LIST \_\_\_\_\_

1. 1. sing 2. sit 3. sin 6. sill 4. sip 5. sick	2. 6. look 3. shook 4. cook 2. took 5. hook 1. book	3. 2. vest 6. rest 1. nest 4. test 5. best 3. west	4. 6. kill 3. kid 4. kit 2. king 1. kith 5. kiss	5. 5. putt 2. puff 6. pub 1. pun 3. pup 4. pug
6. 3. fin 2. fig 6. fit 5. fib 1. fill 4. fizz	7. 5. toil 3. boil 1. foil 6. soil 2. coil 4. oil	8. 3. rust 4. must 2. just 5. gust 6. dust 1. bust	9. 4. rig 5. pig 2. wig 3. big 1. jig 6. fig	10. 4. sane 3. save 5. safe 6. same 2. sale 1. sake
11. 2. bit 6. hit 4. sit 6. wit 3. fit 1. kit	12. 1. came 2. cape 3. cane 4. cake 5. cave 6. case	13. 3. hold 6. cold 4. fold 5. gold 2. told 1. sold	14. 5. mass 1. map 3. math 4. man 6. mad 2. mat	15. 5. sale 6. pale 1. gale 4. bale 2. male 3. tale
16. 1. raw 6. saw 2. paw 5. thaw 4. jaw 3. law	17. 5. rent 3. went 1. dent 6. sent 4. tent 2. bent	18. 3. pace 5. pale 1. page 4. pay 6. pave 2. pane	19. 3. came 6. game 4. name 1. fame 2. same 5. tame	20. 4. dub 3. dull 6. dun 1. duck 2. dud 5. dug
21. 2. rake 1. rave 6. ray 5. raze 4. rate 3. race	22. 6. bill 2. hill 5. fill 1. will 3. kill 4. till	23. 6. pan 3. pang 4. pad 1. pass 2. pat 5. path	24. 5. keel 1. peel 2. reel 6. eel 3. feel 4. heel	25. 2. bus 1. bun 4. buff 5. buck 6. bug 3. but
26. 2. heath 5. heat 4. heave 1. hear 3. heal 6. heap	27. 3. sag 4. sack 6. sat 2. sass 5. sap 1. sad	28. 3. gun 2. nun 6. run 1. sun 5. bun 4. fun	29. 6. tick 4. pick 3. sick 5. wick 2. lick 1. kick	30. 3. cuff 4. cup 5. cud 2. cub 6. cuss 1. cut
31. 1. peace 3. peak 6. peach 5. peat 4. peal 2. peas	32. 6. pay 1. way 4. gay 2. may 3. say 5. day	33. 3. den 2. pen 4. hen 6. men 1. ten 5. then	34. 4. seat 5. beat 1. meat 3. heat 2. feat 6. neat	35. 4. dip 5. hip 2. rip 1. sip 6. lip 3. tip
36. 2. dip 6. din 4. dim 3. did 1. dig 5. dill	37. 5. ceam 6. teak 3. tease 2. tear 1. teach 4. teal	38. 3. sub 4. sun 6. sung 5. sup 1. sud 2. sum	39. 4. pig 1. pill 5. pin 2. pick 3. pip 6. pit	40. 5. fed 3. red 2. shed 6. wed 4. bed 1. led
41. 5. mop 6. shop 1. top 2. hop 4. cop 3. pop	42. 5. lane 6. lame 4. lace 3. lay 2. lake 1. late	43. 2. beach 3. beat 1. bean 6. beak 5. bead 4. beam	44. 5. sang 6. hang 3. gang 4. bang 1. rang 2. fang	45. 1. seep 4. seed 5. seem 3. seethe 2. seen 6. seek
46. 5. park 2. dark 3. mark 6. bark 4. lark 1. hark	47. 1. pin 5. din 2. sin 3. tin 6. fin 4. win	48. 1. tab 4. tang 2. tan 3. tam 5. tac 6. tap	49. 6. bath 3. back 1. bat 5. ban 4. bass 2. bad	50. 1. hot 3. not 6. tot 2. got 5. lot 4. pot

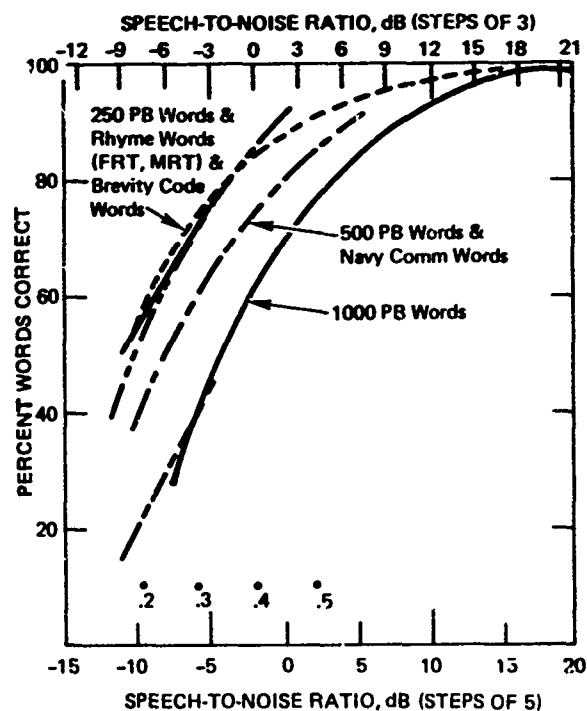


Figure 2. PB, rhyme, brevity code, and Navy communication word intelligibility as a function of speech-to-noise ratio and AL.

## NUMBER OF SYLLABLES

Another factor affecting speech intelligibility scores is the number of syllables in a word. Bisyllabic words with equal stress on each syllable (railroad, birthday, etc.), called spondees, or spondaic words, have long been used clinically for determining degree of deafness and evaluating hearing aids. However, since this document is intended to be a handbook of speech tests for evaluating equipment, only passing mention is made of tests used primarily in a speech and hearing clinic.

An early and much-used spondee test was developed as Psycho-Acoustic Laboratory (PAL) Auditory Test 9; see Hudgins, Hawkins, Karlin, and Stevens (1947) and for later modification, Hirsh et al (1952). The Hirsh list is shown in exhibit 11. Spondaic words are the easiest of word tests and, if used in equipment evaluation, should be used primarily for setting voice levels, since the equally stressed syllables make it easy to monitor VU or other sound level meters.

## EXHIBIT 11: HIRSH SPONDEES.

### SPONDAIC WORDS OF CID AUDITORY TESTS W-1 AND W-2

1. airplane	10. eardrum	19. iceberg	28. railroad
2. armchair	11. farewell	20. inkwell	29. schoolboy
3. baseball	12. grandson	21. mousetrap	30. sidewalk
4. birthday	13. greyhound	22. mushroom	31. stairway
5. cowboy	14. hardware	23. northwest	32. sunset
6. daybreak	15. headlight	24. oatmeal	33. toothbrush
7. doormat	16. horseshoe	25. padlock	34. whitewash
8. drawbridge	17. hotdog	26. pancake	35. woodwork
9. duckpond	18. hothouse	27. playground	36. workshop

### PHONETIC ELEMENTS

It has been well established in the experimental literature that vowels have greater sound pressure levels than consonants and that certain vowels – and consonants – are higher in basic vocalic level than others. Since vowels tend to be heard better under adverse conditions than consonants, it is confusion among consonants that causes confusion among words. Therefore, the statement is often made that consonants determine word intelligibility. From the beginning, attempts have been made to balance word lists with phonetic elements in the same proportion that occurs in “everyday” English. However, in many instances, especially in systems involving extensive speech processing, it is important to determine exactly which phonetic elements are intelligible and which are not.

All the rhyme tests so far discussed (Fairbanks, Kreul et al, House et al) have been consonant tests. Vowel rhyme tests are not so numerous but at least one has been developed for potential armed service use. The words of Clarke’s (1965) phonetically balanced rhyme test for vowels (medial position between two consonants) are listed in exhibit 12. A typical answer sheet is shown in exhibit 13, and the phonetic structure of the test in exhibit 14.

Phonetic (consonant) analyses of the Fairbanks (1958) test and of the Modified Rhyme Tests are shown in exhibits 15 and 16. Tables 14-16 are shown as aids to anyone who really needs this depth of analysis in using the word tests.

A special test has been developed, with computerized scoring, to test diagnostically for phonetic confusion. Exhibit 17 lists the word (or syllable) pairs of Voiers’s (1967, 1971) Diagnostic Rhyme Test (DRT) and exhibit 18 shows the phonetic composition of the DRT. Use of the DRT is suggested for detailed testing in the development phases of vocoders or complex speech processing systems. The listener is forced to respond to one of two fixed and known foils.

# EXHIBIT 12: CLARKE'S PBRT(V) WORD LIST.

1. AT	51. PATE	101. LET	151. PEA	201. SLIGHT
2. BAD	52. FEAR	102. LICK	152. PEER	202. SLIT
3. BAIL	53. FELL	103. LID	153. PEN	203. SLOT
4. BAIT	54. FIGHT	104. LIE	154. PEP	204. SOAK
5. BALL	55. FILE	105. LIGHT	155. PET	205. SOCK
6. BAND	56. FILL	106. LIKE	156. PIE	206. SOD
7. BEAD	57. FIT	107. LIMB	157. PILE	207. SON
8. BED	58. FOOT	108. LIME	158. PILL	208. SOON
9. BELL	59. FOR	109. LIST	159. PIN	209. SPAN
10. BEND	60. FOUGHT	110. LIT	160. PIPE	210. SPIN
11. BET	61. FOUL	111. LOAD	161. PIT	211. SPINE
12. BID	62. FUR	112. LOCK	162. POLE	212. SPOON
13. BIND	63. GATE	113. LOOK	163. POOL	213. SPUN
14. BIRD	64. GET	114. LOOM	164. POOR	214. STACK
15. BIT	65. GOAT	115. LOST	165. POP	215. STAKE
16. BOAT	66. GOT	116. LOT	166. POPE	216. STALK
17. BOND	67. GUT	117. LOUD	167. POT	217. STALL
18. BOUND	68. HAD	118. LOW	168. POUR	218. SLAR
19. BOUT	69. HAIL	119. MAR	169. POUT	219. STARE
20. BOWL	70. HALL	120. MARE	170. PUP	220. STEER
21. PRAID	71. HAM	121. MAT	171. RAID	221. STICK
22. BREAD	72. HAT	122. MATE	172. RAT	222. STILL
23. BREED	73. HEAD	123. MEET	173. RATE	223. STIR
24. BROAD	74. HEAT	124. MERE	174. RED	224. STOCK
25. BROOD	75. HEED	125. MESS	175. RID	225. STOLE
26. BULL	76. HEM	126. MET	176. RIGHT	226. STOOL
27. CALL	77. HID	127. MIGHT	177. ROAD	227. STORE
28. COAL	78. HILL	128. MISS	178. ROD	228. STYLE
29. CCIL	79. HIM	129. MOOR	179. ROT	229. SUCK
30. COOL	80. HIT	130. MORE	180. RUT	230. SUIT
31. COWL	81. HOLE	131. MOSS	181. SAD	231. TALE
32. DALE	82. HOME	132. MOUSE	182. SAID	232. TALL
33. DAME	83. HOOD	133. MUSS	183. SAKE	233. TAP
34. DAWN	84. HOT	134. NET	184. SANE	234. TAPE
35. DEAN	85. HOWL	135. NIGHT	185. SAT	235. TEA
36. DELL	86. HUM	136. NOT	186. SEAT	236. TELL
37. DEN	87. HURT	137. NOTE	187. SEED	237. TEN
38. DIME	88. IT	138. NUT	188. SET	238. TIE
39. DIN	89. LAID	139. OAT	189. SHEET	239. TILL
40. DOLE	90. LAKE	140. OUT	190. SHIRT	240. TIN
41. DOLL	91. LAMB	141. PA	191. SHOOT	241. TIP
42. DOME	92. LAME	142. PAIN	192. SHOT	242. TO
43. DOOM	93. LAST	143. PAIR	193. SHOUT	243. TOE
44. DOWN	94. LATE	144. PALE	194. SICK	244. TONE
45. DULL	95. LAW	145. PAN	195. SIDE	245. TOOL
46. DUMB	96. LAY	146. PAR	196. SIGN	246. TOP
47. EAT	97. LEAST	147. PAT	197. SIN	247. TOWN
48. FAIL	98. LED	148. PAW	198. SIT	248. TOY
49. FAIR	99. LEE	149. PAWN	199. SLAT	249. TURN
50. FAR	100. LEST	150. PAY	200. SLATE	250. TYPE

**EXHIBIT 13: CLARKE'S PBRT(V) ANSWER SHEET.**

Name _____ List _____ Equip. _____ Date _____				
Talker _____ Talker's Mic _____ Replication # _____				
1. IT	AT	OAT	EAT	OUT
2. MISS	MUSS	MESS	MOSS	MOUSE
3. BID	BIRD	BED	BAD	BEAD
4. DULL	DELL	DOLL	DALE	DOLE
5. PUP	PEP	PIPE	POP	POPE
6. SICK	SUCK	SOCK	SAKE	SOAK
7. STICK	STALK	STOCK	STACK	STAKE
8. DIN	DEN	DAWN	DEAN	DOWN
9. BREAD	BROAD	BRAID	BREED	BROOD
10. RID	RED	ROD	RAID	ROAD
11. HIT	HURT	HOT	HAT	HEAT
12. HILL	HALL	HAIL	HOLE	HOWL
13. PIT	PET	PAT	POT	POUT
14. FILL	FELL	FILE	FAIL	FOUL
15. HIM	HUM	HEM	HAM	HOME
16. SHIRT	SHOT	SHEET	SHOOT	SHOUT
17. FIT	FIGHT	FOUGHT	FATE	FOOT
18. LIMB	LIME	LAMB	LAME	LOOM
19. PEER	PAIR	PAR	POUR	POOR
20. LID	LED	LAID	LOAD	LOUD
21. HID	HEAD	HAD	HEED	HOOD
22. PILL	PILE	PALE	POLE	POOL
23. SLIT	SLIGHT	SLOT	SLAT	SLATE
24. NUT	NET	NIGHT	NOT	NOTE
25. CALL	COAL	COOL	COWL	COIL
26. SIN	SON	SIGN	SANE	SOON
27. LIT	LET	LIGHT	LOT	LATE
28. TIP	TYPE	TOP	TAP	TAPE
29. STEER	STIR	STARE	STAR	STORE
30. TIE	TOE	TEA	TO	TOY
31. SIT	SET	SAT	SEAT	SUIT
32. LIE	LAW	LAY	LOW	LEE
33. BELL	BALL	BAIL	BOWL	BULL
34. BIT	BET	BAIT	BOAT	BOUT
35. DUMB	DIME	DAME	DOME	DOOM
36. SPIN	SPUN	SPINE	SPAN	SPOON
37. MET	MIGHT	MAT	MATE	MEET
38. RUT	RIGHT	ROT	RAT	RATE
39. TIN	TURN	TEN	TOE	TOWN
40. GUT	GET	GOT	GATE	GOAT
41. LIST	LEST	LOST	LAST	LEAST
42. LICK	LIKE	LOCK	LAKE	LOOK
43. MERE	MARE	MAR	MORE	MOOR
44. FEAR	FUR	FAIR	FOR	FAR
45. TILL	TELL	TALL	TALE	TOOL
46. PIN	PEN	PAWN	PAN	PAIN
47. BEND	BIND	BOND	BAND	BOUND
48. STILL	STYLE	STALL	STOLE	STOOL
49. SAID	SIDE	SOD	SAD	SEED
50. PIE	PAW	PA	PAY	PEA

**EXHIBIT 14: CLARKE'S PBRT(V) PHONETIC STRUCTURE.**

### Phonetic Symbol

### Key Word

[illegible]

<b>ALPHA- BETICAL LISTING</b>	<b>RANDOM- IZED LISTING</b>
---------------------------------------	-------------------------------------

[illegible]

EXHIBIT 14 (Continued).

Phonetic Symbol			æ	ɑ	ɔ	ɛ	ɛ	ɪ	ai	ə	o	u	ɪ	ɛ	ɑ						
Key Words			bat	calm	lay	late		bat	beat		bit	dine	bird		soap	cool	cook	bold		how	cut
Items	Word Foils																				
ALPHA-BETICAL LISTING	RANDOM-IZED LISTING																				
25.	43)	{ m - r }	a								oo										
		{ m - re }		o		a		e													
26.	2)	m - s(e)		o		e		i											ou	u	
		{ m - ght }						i													
27.	37)	{ m - t }	a			e	ee														
		{ m - te }			a																
		{ n - ght }						i													
28.	24)	{ n - t }		o		e															u
		{ n - te }									o										
29.	50)	p -	a	aw	ay		ea	ie													
30.	22)	{ p - le }			a			i			o										
		{ p - l(1) }						i			oo										
31.	46)	p - n	a	aw	ai		e	i													
32.	5)	p - p		o			e														u
		p - pe						i			o										
33.	19)	p - r	a		ai		ee				oo								cu		
34.	13)	p - t	a	o			e	i											ou		
35.	10)	r - d		o	ai		e	i			oa										
		{ r - ght }						i													
36.	38)	{ r - t }	a	o																	u
		{ r - te }			a																
37.	6)	{ s - ck }		o				i													u
		{ s - k(e) }			a						oa										
38.	49)	s - d(e)	a	o			ai	ee	i												
		{ s - gn }						i													
39.	26)	{ s - n }						i			oo								o		
		{ s - ne }			a																
40.	31)	s - t	a				e	ea	i			ui									
41.	16)	sh - t		o				ee		ir	oo								ou		
		{ sl - ght }							i												
42.	23)	{ sl - t }	a	o					i												
		{ sl - te }			a																
43.	36)	sp - n	a					i			oo										u
		{ sp - ne }						i													

**EXHIBIT 14 (Continued).**

### Phonetic Symbol

### Key Word

[illegible]

<b>ALPHA- BETICAL LISTING</b>	<b>RANDOM- IZED LISTING</b>
---------------------------------------	-------------------------------------

44. 7)

$$\left\{ \begin{array}{l} \text{st - ck} \\ \text{st - ke} \\ \text{st - lk} \end{array} \right\}$$

45. 48)

$$\begin{Bmatrix} \text{st} - \text{le} \\ \text{st} - 1(1) \end{Bmatrix}$$

46. 29)

$$\begin{Bmatrix} \text{st} - r \\ \text{st} - re \end{Bmatrix}$$

47. 30)

t -

48. 45)

$$\begin{cases} t = 1e \\ t = 1(1) \end{cases}$$

49. 39)

$$t - n(e)$$

{ t - p  
t - pe }

Number

[illegible]

**EXHIBIT 15: FAIRBANKS' RHYME TEST PHONETIC STRUCTURE.**

		Consonants																			
No.	Vowels or Diphthongs																				
		b	k	d	f	g	h	dz	j	k	l	m	n	p	r	s	t	v	w	j	z
1	— ack (ae)	b						j		l				p	r	s					
2	— age (e)		c											p	r	s		w			
3	— ail (e)				f						m	n				s	t				
4	— ain (e)					g					m			p	r			v			
5	— ake (e)		c							l							t		w		
6	— ale (e)	b									m			p		s	t				
7	— ame (e)		c		f	g						n				s					
8	— ang (ae)	b				g	h								r	s					
9	— ark (a)	b		d						l	m			p							
10	— ast (ae)		c		f					l	m			p							
11	— ate (e)			d		g	h			l					r						
12	— aw (ɔ)							j		l				p	r	s					
13	— ay (e)			d							m			p		s		w			
14	— eal (i)			d			h				m					s					z
15	— eat (i)	b					h				m	n				s					
16	— ed (ɛ)	b			f					l					r			w			
17	— eel (i)				f		h		k					p	r						
18	— ell (ɛ)	b			f											s	t	w			
19	— en (ɛ)			d			h				m			p			t				
20	— end (ɛ)	b								l	m					s	t				
21	— ent (ɛ)	b													r	s	t	w			
22	— est (ɛ)	b										n			r		t	w			
23	— et (ɛ)					g				l	m					s			y		
24	— ick (I)								k	l				p		s	t				
25	— id (I)	b		d			h		k						r						
26	— ide (aI)						h								r	s	t	w			
27	— ig (I)	b		d	f									p				w			
28	— ight (aI)				f					l	m	n		p							
29	— ile (aI)				f						m			p			t	v			
30	— ill (I)	b			f				k								t	w			
31	— in (I)			d										p		s	t	w			
32	— ink (I)									l	m			p		s		w			
33	— ine (aI)				f					l	m	n						w			
34	— ip (I)			d			h			l					r		t				
35	— ire (aI)				f		h									s	t	w			
36	— it (I)	b			f		h									s		w			
37	— ock (a)		c	d						l	m				r						
38	— od (a)		c			g						n			r	s					
39	— oil (ɔI)	b	c		f											s	t				
40	— old (o)		c			g	h										s	t			
41	— ook (v)	b	c				h			l								t			
42	— oon (u)	b	c								m	n				s					
43	— op (a)		c				h				m			p			t				
44	— ore (ɔ)	b									m					s	t	w			
45	— orn (ɔ)	b	c				h										t	w			
46	— ot (a)					g	h			l		n	p								
47	— uck (ʌ)	b		d						l						s	t				
48	— ump (ʌ)	b		d				j		l				p							
49	— un (ʌ)				f	g						n			r	s					
50	— ust (ʌ)	b		d				j			m				r						
TOTAL	250	22	12	13	15	9	16	4	4	19	21	10	18	17	27	22	2	17	1	1	
		b	(k) c	d	f	g	h	(dz) j	k	l	m	n	p	r	s	t	v	w	(j) y	z	

EXHIBIT 16: KREUL ET AL MODIFIED RHYME TEST PHONETIC STRUCTURE.

KREUL, ET AL (CLINICAL) MODIFIED RHYME TEST																									
No.	Root	V O W E L	Initial Consonant																						
			b	c	ch	d	f	g	h	j	l	m	n	ng	p	r	s	sh	t	th	th	v	w	y	z
				k	ts					dz				ŋ				ʃ		ð	e				j
1	-ale	e	b				g				m			p		s		t							
2	-ame	e		c			f	g				n				s		t							
3	-ang	ae	b				f	g	h						r	s									
4	-ark	a	b			d			h		l	m			p										
5	-aw	ɔ								j	l				p	r	s				th				
6	-ay	e				d		g				m			p		s						w		
7	-eat	i	b				f		h			m	n				s								
8	-ed	ɛ	b				f				l				r		sh						w		
9	-eel	i		k			f		h						p	r								-	
10	-en	ɛ				d			h			m			p				t	th					
11	-ent	ɛ	b			d									r	s		t					w		
12	-est	ɛ	b										n			r			t			v	w		
13	-ick	I		k							l				p		s		t				w		
14	-ig	I	b			(d)	f			ɟ					p	r							w		
15	-ill	I	b	k			f		h										t				w		
16	-in	I				d	f								p		s		t				w		
17	-ip	I				d			h		l					r	s		t						
18	-it	I	b	k			f		h								s						w		
19	-oil	ɔI	b	c			f										s		t					-	
20	-old	o		c			f	g	h								s		t						
21	-ook	v	b	c					h		l							sh	t						
22	-op	a		c					h			m			p			sh	t						
23	-ot	a						g	h		l		n		p				t						
24	-un	ʌ	b				f	g					n			r	s								
25	-ust	ʌ	b			d		g		j		m				r									
TOTAL			14	9	0	7	12	8	12	3	7	7	5	0	11	10	14	3	14	1	1	1	9	2	0

(HOUSE, et al +1 -1 )

EXHIBIT 16 (Continued).

KREUL, ET AL (CLINICAL) MODIFIED RHYME TEST																									
No.	Root	V O W E L	Final Consonant																						
			b	c	ch	d	f	g	h	i	l	m	n	ng	p	r	s	sh	t	th	th	v	w	y	z
					k	ts													s						
26	ba -	ae		ck		d						n				ss		t		th					
27	bea -	i		k	ch	d					m	n						t							
28	bu -	^		ck			ff	g				n				s		t							
29	ca -	e		ke							me	ne		pe		se					ve				
30	cu -	^	b			d	ff							p		ss		t							
31	di -	I			d		g			ll	m	n		p											
32	du -	^	b	ck		d		g		ll		n	(ng)												
33	fi -	I	i				g			ll		n						t						zz	
34	hea -	i								l				p	r			t		th	ve				
35	ki -	I		(ck)		d				ll		(n)	ng			ss		t		th					
36	la -	e		ke							me	ne				ce		te					y		
37	ma -	ae			d							n		p		ss		t		th					
38	pa -	ae		(ck)		d						n	ng			ss		t		th					
39	pa -	e								ge	le		ne			ce					ve		y		
40	pea -	i		k	ch					l						ce		t						s	
41	pi -	I		ck			g			ll		n		p				t							
42	pu -	^	b	(ck)		ff	g					n		p		(s)		tt							
43	ra -	e		ke												ce		te			ve		y	ze	
44	sa -	ae		ck		d		g						p		ss		t							
45	sa -	e		ke			fe				le	me	ne								ve				
46	see -	i		k		d					m	n		p					the						
47	si -	I		ck						ll		n	ng	p				t							
48	su -	^	b			d					m	n	ng	p											
49	ta -	ae	b	ck							m	n	ng	p											
50	tea -	i		k	ch					l	m				r									se	
TOTAL			6	15	3	11	4	7	0	1	11	9	18	5	12	2	12	0	16	1	5	5	0	3	4
GRAND TOTAL			20	24	3	18	16	15	12	4	18	16	23	5	23	12	26	3	30	2	6	6	9	5	4

(House, et al +3 (+1) -1 (-1) -1 +1 0 0 -1 -1 )

# EXHIBIT 17: VOIERS'S DIAGNOSTIC RHYME TEST.

1. BAD	48. DENSE	94. JEST	140. PEEN	186. TENSE
2. BANK	49. DID	95. JILT	141. PEG	187. TENT
3. BAT	50. DILL	96. JACK	142. PENCE	188. TEST
4. BEAN	51. DINT	97. JOE	143. PENT	189. THAD
5. BEAT	52. DIP	98. JOT	144. PEST	190. THAN
6. BEE	53. DOCK	99. JUICE	145. POND	191. THANK
7. BEND	54. DOLE	100. KEEP	146. POOH	192. THAW
8. BID	55. DONG	101. KEG	147. POOL	193. THEE
9. BILL	56. DOT	102. KEY	148. POOP	194. THEN
10. BIT	57. DOTE	103. KNOCK	149. POT	195. THICK
11. BOAST	58. DOUGH	104. LAMP	150. RAMP	196. THIN
12. BOB	59. DOZE	105. LAP	151. RAP	197. THING
13. BOOT	60. DUES	106. LAW	152. RAW	198. THONG
14. BOMB	61. DUNE	107. LEAK	153. REAP	199. THOLE
15. BON	62. FAD	108. LEAP	154. REED	200. THOR
16. BOND	63. FAN	109. LEND	155. REEK	201. THOSE
17. BONE	64. FAST	110. LEST	156. REND	202. THOUGH
18. BONG	65. FAULT	111. LEWD	157. REST	203. THOUGHT
19. BOSS	66. FEEL	112. LID	158. RID	204. TICK
20. BOWL	67. FENCE	113. LIP	159. RIP	205. TINT
21. BOX	68. FIN	114. LOAD	160. ROAD	206. TONG
22. CALF	69. FIT	115. LOCK	161. ROCK	207. TOOL
23. CARE	70. FOAL	116. LONG	162. ROD	208. TOOT
24. CAUGHT	71. FOO	117. LOOT	163. ROOT	209. TOT
25. CHAD	72. FOP	118. LOT	164. ROT	210. TUNE
26. CHAIR	73. FORE	119. LOW	165. ROW	211. VAST
27. CHAW	74. FOUGHT	120. MAD	166. RUDE	212. VAULT
28. CHEAT	75. GAB	121. MEAT	167. RUE	213. VEAL
29. CHEEP	76. GAFF	122. MEND	168. SAG	214. VEE
30. CHEW	77. GAT	123. MET	169. SAID	215. VILL
31. CHIN	78. GAUZE	124. MIT	170. SANK	216. VOLE
32. CHOCK	79. GHOST	125. MOAN	171. SAW	217. VON
33. CHOOSE	80. GILL	126. MOM	172. SHAD	218. VOX
34. CHOP	81. GILT	127. MOON	173. SHAG	219. WAD
35. COAT	82. GIN	128. MOOT	174. SHAW	220. WALL
36. COOL	83. GNAW	129. MOSS	175. SHEET	221. WEED
37. COOP	84. GO	130. NAB	176. SHOES	222. WIELD
38. COOT	85. GOAT	131. NECK	177. SHOW	223. WREN
39. COP	86. GOB	132. NEED	178. SING	224. WRONG
40. DAB	87. GOOSE	133. NET	179. SO	225. YAWL
41. DAN	88. GOT (2)	134. NEWS	180. SOLE	226. YEN
42. DANK	89. GUEST	135. NIP	181. SUE	227. YIELD
43. DAUNT	90. HIT	136. NOON	182. TAUGHT	228. YOU
44. DAW	91. HOP	137. NOTE	183. TAUNT	229. ZED
45. DECK	92. JAB	138. PAN	184. TEA	230. ZEE
46. DEED	93. JAWS	139. PEAK	185. TEAK	231. ZOO
47. DEN				

EXHIBIT 17 (Continued).

BOB - GOB	COOT - TOOT
DAUNT - TAUNT	POND - BOND
MOOT - BOOT	BONE - MOAN
SHEET - CHEAT	BILL - VILL
GAB - JAB	GUEST - JEST
TOT - POT	FOUGHT - THOUGHT
BOAST - GHOST	POOP - COOP
RIP - LIP	LEAP - REAP
SAID - ZED	FAST - VAST
GNAW - DAW	KNOCK - DOCK
SHOES - CHOOSE	DOZE - THOSE
KEEP - CHEEP	SING - THING
DANK - BANK	NET - MET
DOT - GOT	CAUGHT - TAUGHT
ROAD - LOAD	LEWD - RUDE
TINT - DINT	BEAN - PEEN
DECK - NECK	MAD - BAD
TONG - THONG	BOX - VOX
CHEW - COO	JOE - GO
REED - WEED	DID - BID
SAG - SHAG	WREN - YEN
LOT - ROT	LAW - RAW
FOAL - VOLE	ZOO - SUE
DIP - NIP	NEED - DEED
FENCE - PENCE	THAN - DAN
THAW - SAW	CHOP - COP
POOL - TOOL	FORE - THOR
YIELD - WIELD	FIT - HIT
LAP - RAP	LEST - REST

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## EXHIBIT 18: PHONETIC COMPOSITION OF DRT.

This is reproduced from Table 2 of Voiers (1967) (or Table 1, Voiers, 1971) CONSONANT TAXONOMY USED IN THE CONSTRUCTION OF THE DRT (FORM III)																							
	/m/	/n/	/v/	/ð/	/z/	/3/	/Δ/ <sub>3</sub>	/b/	/d/	/g/	/w/	/r/	/l/	/j/	/ɛ/	/θ/	/s/	/ʃ/	/ʒ/	/p/	/t/	/k/	/h/
Voicing	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
Nasality	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sustention	-	-	+	+	+	+	-	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	+
Sibilation	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Graveness	+	-	+	-	-	o	o	+	-	o	+	-	o	o	+	-	-	o	o	+	-	o	o
Compactness	-	-	-	-	-	+	+	-	-	+	-	-	o	+	-	-	-	+	+	-	-	+	o
Vowel-like*	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-

\* The DRT does not test for the apprehensibility of the opposition, vowel-like - nonvowel-like. However, test words are chosen so as not to confound this attribute with the six attributes for which discriminability is tested.

\* The DRT does not test for the apprehensibility of the opposition, vowel-like - nonvowel-like. However, test words are chosen so as not to confound this attribute with the six attributes for which discriminability is tested.

## CONTEXT

The context within which the word is heard provides the greatest contribution to the word's intelligibility. There are many forms of context — grammatical, linguistic, situational, semantic, etc. An air controller has as much trouble understanding a tobacco auctioneer as either one would have in understanding a Japanese kabuki drama, yet each in turn can understand the gibberish that passes for language in his own work environment.

Sentence tests are often suggested as tests for evaluating communications equipments, or the hearing capabilities of the hard of hearing. Four general types of sentence tests have been developed: single-word answer tests ("What day comes after Tuesday?"), five-key-word sentences ("When the frost has come it is time for turkey"), colloquial speech, and synthetic sentences ("Down by the time is real enough").

Sample lists of sentences of the first two types, taken from Hudgins et al (1947), are shown in exhibits 19 and 20. Examples of colloquial speech, exhibit 21, were compiled by a CHABA working group chaired by Fairbanks and listed by Davis and Silverman (1970) in the appendix to the revised edition of *Hearing and Deafness*. Giolas (1966) has demonstrated a close relationship between the intelligibility of these colloquial sentences and that of samples of continuous discourse.

Speaks and Jerger (1965) and Jerger, Speaks, and Trammell (1968) developed sets of first-, second-, and third-order synthetic sentences to reduce the predictability of key words in regular English sentences while retaining many other good features of sentence testing. Their third-order sentences are shown in exhibit 22. Giolas, Cooker, and Duffy (1971) have shown that the synthetic sentences have indeed eliminated key word predictability as a factor in their sentence lists.

# EXHIBIT 19: HUDGINS ET AL SENTENCES (SINGLE-WORD ANSWERS).

## LIST 1

Level	Answer	Question
0 db	B	1. What letter comes between A and C?
	Yes	2. Do flies have wings?
	Monday	3. What day comes after Sunday?
-6 db	3 or 4	4. How many colors are there in the American Flag?
	11	5. What number comes after 10?
	Hammer	6. What tool do you drive nails with?
-12 db	7	7. What number comes between 6 and 8?
	Yes	8. Are moths dangerous to clothing?
	February	9. What month comes after January?
-18 db	5	10. How many pennies are there in a nickel?
	No	11. Is there a lot of water in the desert?
	Weak	12. What is the opposite of strong?
-24 db	9	13. What number comes before 10?
	Bullets	14. Does a gun shoot flowers or bullets?
	Old	15. What is the opposite of new?
-30 db	France	16. In what country is Paris?
	No	17. Do you climb mountains in a sailboat?
	X	18. What letter comes after W?
-36 db	Tuesday	19. What day comes after Monday?
	Light	20. What is the opposite of dark?
	12	21. What number comes after 11?

# EXHIBIT 20: HUDGINS ET AL FIVE-KEY-WORD SENTENCES.

## LIST 1

1. The birch canoe slid on the smooth planks.
2. Glue the sheet to the dark blue background.
3. It's easy to tell the depth of a well.
4. These days a chicken leg is a rare dish.
5. Rice is often served in round bowls.
6. John is just a dope of long standing.
7. The juice of lemons makes fine punch.
8. The chest was thrown beside the parked truck.
9. The hogs were fed chopped corn and garbage.
10. A cry in the night chills my marrow.
11. Blow high or low but follow the notes.
12. Four hours of steady work faced us.
13. A large size in stockings is hard to sell.
14. Many are taught to breathe through the nose.
15. Ten days leave is coming up.
16. The Frenchman was shot when the sun rose.
17. A rod is used to catch pink salmon.
18. He smoked a pipe until it burned his tongue.
19. The light flashed the message to the eyes of the watchers.
20. The source of the huge river is the clear spring.

EXHIBIT 21: EVERYDAY (CIVILIAN) SPEECH (50 OF 100 SENTENCES).

LIST A

1. Walking's my favorite exercise.
2. Here's a nice quiet place to rest.
3. Our janitor sweeps the floors every night.
4. It would be much easier if everyone would help.
5. Good morning.
6. Open your window before you go to bed!
7. Do you think that she should stay out so late?
8. How do you feel about changing the time when we begin work?
9. Here we go.
10. Move out of the way!

LIST B

1. The water's too cold for swimming.
2. Why should I get up so early in the morning?
3. Here are your shoes.
4. It's raining.
5. Where are you going?
6. Come here when I call you!
7. Don't try to get out of it this time!
8. Should we let little children go to the movies by themselves?
9. There isn't enough paint to finish the room.
10. Do you want an egg for breakfast?

LIST C

1. Everybody should brush his teeth after meals.
2. Everything's all right.
3. Don't use up all the paper when you write your letter.
4. That's right.
5. People ought to see a doctor once a year.
6. Those windows are so dirty I can't see anything outside.
7. Pass the bread and butter please!
8. Don't forget to pay your bill before the first of the month.
9. Don't let the dog out of the house!
10. There's a good ballgame this afternoon.

LIST D

1. It's time to go.
2. If you don't want these old magazines, throw them out.
3. Do you want to wash up?
4. It's a real dark night so watch your driving.
5. I'll carry the package for you.
6. Did you forget to shut off the water?
7. Fishing in a mountain stream is my idea of a good time.
8. Fathers spend more time with their children than they used to.
9. Be careful not to break your glasses!
10. I'm sorry.

EXHIBIT 21 (Continued).

LIST E

1. You can catch the bus across the street.
2. Call her on the phone and tell her the news.
3. I'll catch up with you later.
4. I'll think it over.
5. I don't want to go to the movies tonight.
6. If your tooth hurts that much you ought to see a dentist.
7. Put that cookie back in the box!
8. Stop fooling around!
9. Time's up.
10. How do you spell your name?

EXHIBIT 22: SPEAKS AND JERGER SYNTHETIC SENTENCES  
(THIRD-ORDER APPROXIMATION TO ACTUAL ENGLISH).

Primary Subset

1. SMALL BOAT WITH A PICTURE HAS BECOME
2. BUILT THE GOVERNMENT WITH THE FORCE ALMOST
3. GO CHANGE YOUR CAR COLOR IS RED
4. FORWARD MARCH SAID THE BOY HAD A
5. MARCH AROUND WITHOUT A CARE IN YOUR
6. THAT NEIGHBOR WHO SAID BUSINESS IS BETTER
7. BATTLE CRY AND BE BETTER THAN EVER
8. DOWN BY THE TIME IS REAL ENOUGH
9. AGREE WITH HIM ONLY TO FIND OUT
10. WOMEN VIEW MEN WITH GREEN PAPER SHOULD

Secondary Subset

11. OWN LOT IN YOUR AMERICAN FOOD HAS
12. IS MEETING IN THE COLLEGE OF THE
13. US WITHOUT FIRST THOUGHT WAS VERY NICE
14. AGREE WITH US IT ONLY SHALL COOK
15. WITH HUMAN NATURE CAN BE MET AT
16. IN OUR DIFFERENT NAME BECAUSE HE CAN'T
17. MARCH AROUND THE TIME WAS EVERYTHING THAT
18. MOPE OF IT IS CERTAIN TO BE
19. WILL GO TO SCHOOL TODAY WAS THE
20. SO ALLOW US TO THE SOUND AND

## VALIDITY FACTORS

To evaluate operational equipment, or the performance of operating personnel, the test language and talker/listener team should be related in some known way to the language and personnel actually employed on the system (equipment, component) under test.

The use and/or pronunciation of certain digits, words, and short phrases are specified in specific operational situations. For example, exhibit 23 lists (at the bottom) the International Civil Aeronautics Organization (ICAO) phonetic spelling words (see Moser and Dreher (1955)) and digit pronunciation, and (at the top) a selected list of Brevity Code words for naval aircraft operations. This listing has been compiled for special testing of naval aircraft radios.

Webster and Allen (1972) reported on the speech intelligibility of USN aircraft radios and in the process made some recordings of radio transmissions of a squadron of USN aircraft on a combat mission over the Republic of Vietnam. Some of these recordings are transcribed as exhibit 24.

Walker and Black (1950) prepared 20 flight phrases equated in intensity and duration for test purposes; see exhibit 25.

Major Donald Gasaway, of the USAF, has compiled a list of words extracted from many hours of in-flight recordings in USAF aircraft.\* Gasaway's words are shown in exhibit 26, together with some statistics on how familiar the words are (frequency of usage per million words); whether they are represented in the standard word tests shown in exhibits 1, 7, 9, 12, and 17; and whether they are included among the Brevity Code words.

The U. S. Army Test and Evaluation Command (1971) has prepared the lists of tactical field messages shown in exhibit 27. The report specifies exactly how the testing is to be accomplished, to wit:

"The test project officer will designate the net stations to be used for transmitting and receiving initial messages and the type messages to be used. He will assure that stations are properly manned with qualified "talkers and listeners." After procedural messages have been exchanged, the designated "talker" will transmit the designated test message in a clear, strong voice, spacing the characters/words only to the extent that proper enunciation is effected. If messages selected from Exhibit 27 contain more than 10 words/characters, the "talker" must bear in mind that the messages are being transcribed by hand and pause after each 3 or 4 words. If practicable, tape record the test messages at the transmitting station for subsequent comparison with received messages in order to eliminate from evaluation errors made by the "talkers." "Listeners" at the receiving net stations will manually transcribe all test messages. Listeners should be required to add any appropriate comments relative to characters/words that may be missed or about which they are uncertain. Sufficient log entries will be

---

\*Gasaway is now developing a test to evaluate the auditory performance of air crew members, in particular to test in situ experienced personnel who have lost some hearing acuity as determined by standard clinical tests on the ground. C. Williams and J. W. Greene are working on similar tests for naval air crewmen, see Greene (1970).

made at all stations to fully identify each test message. Selected transmissions will be recorded at the receiving station for comparison with recordings made at the transmitting station in order to evaluate the quality of the communications equipment being tested.

**NOTE:** For purposes of this test no repeats of test messages will be made.

"Transmitting and receiving responsibilities will be rotated among all or selected stations in the communication net in turn. "Talkers" and "listeners" will be rotated at each station for each test message to be transmitted. Sufficient test messages will be transmitted to give a high degree of confidence in the test results.

"Each manually transcribed test message will be checked against the transmitted messages to determine its accuracy.

"Individual letters and numerals will be pronounced using the phonetic alphabet."

Klumpp and Webster (1960) studied the language used on the flight deck of aircraft carriers as part of a study to evaluate man-worn radio equipment. One hundred and fifty flight deck phrases are listed in exhibit 28 and 100 words are extracted and listed in exhibit 29.

Webster and Henry in a report prepared for the SAMSF (Shipboard Aviation Maintenance Space and Support Facilities) Review Committee of NAVSHIPS, NAVAIR, and NAVSUP (see NAVSHIPS (1972)), have compiled the lists of aviation maintenance/supply support messages shown in exhibit 30. Note in this case the preponderance of alphanumeric symbols transmitted.

**EXHIBIT 23: BREVITY CODE WORDS FOR NAVAL AIRCRAFT OPERATIONS AND  
INTERNATIONAL CIVIL AERONAUTICS ORGANIZATION  
PHONETIC SPELLING WORDS.**

1. ABORT	49. CLARA	96. FLYING AT
2. ABORTING	50. CLEARED	97. FOX
3. AFFIRM	51. CLUTTER	98. FRAME
4. AFFIRMATIVE	52. COCKROACH	99. FREE LANCE
5. AIRBORNE	53. CODE	100. FRIENDLY
6. ALTITUDE	54. CONDITION	101. FUEL
7. ANCHORED	55. CONFUSED	
8. ANYCAP	56. CONTACT	102. GADGET
9. ANGELS	57. CONTINUE	103. GATE
10. ANGLE	58. COVER	104. GEIGER
11. ANY FACE	59. CREW	105. GERONIMO
12. APPROACH	60. CROSSING	106. GOBLIN
13. ARK		107. GOODYEAR
14. ASPRO	61. DADCAP	108. GRANDSLAM
15. ASSUME	62. DANGER	109. GRAPHIC
16. AUTOCAT	63. DAVEY JONES	110. GUESSER
17. AWAY	64. DAYRECCO	111. GUNS FREE
	65. DEAF	112. GUNS TIGHT
18. BARS	66. DECIMAL	113. GYRO
19. BARCAP	67. DECK CLEAR	
20. BASE	68. DECK FOUL	114. HARD
21. BATTERY	69. DECOY	115. HAWK
22. BAY RUM	70. DELTA	116. HEADING
23. BELLHOP	71. DETACH	117. HEADS UP
24. BENCH MARK	72. DITCH	118. HECKLERS
25. BENT	73. DITCHING	119. HELOT
26. BINGO	74. DIVERT	120. HELP
27. BINGO FIELD	75. DOLLY	121. HIGH
28. BINGO STATE	76. DRONE	122. HOLD
29. BIRD	77. DUCKBUTT	123. HOLDING
30. BLIND	78. DUD	124. HOMER
31. BOGEY	79. DUMBO	125. HOTEL FIRE
32. BOWWAVE		126. HOSTILE
33. BREAK	80. EASE TURN	127. HUGO
34. BROWNIE	81. ELEVATOR	128. HUNTSMEN
35. BULLMOOSE	82. EMERGENCY	129. HUSH
36. BUSTER	83. EMERGENCY SPACE	
	84. ENGAGE	130. IDENT
37. CAP	85. ESTIMATE	131. IDENTIFY
38. CAPREP	86. EVERGREEN	132. I GO
39. CAUTION		133. INTERFERENCE
40. CAVU	87. FADED	134. IN THE DARK
41. CEASE REPORTING	88. FAMISHED	135. INTRUDERS
42. CHARLIE	89. FEAR	136. I STAY
43. CHASE	90. FEET DRY	
44. CHECK	91. FEET WET	137. JUDY
45. CHERUBS	92. FERRET	
46. CHICKS	93. FEW	138. KEEPER
47. CHOPPER	94. FINAL	
48. CIGAR	95. FLY AT	139. LAMPS

# EXHIBIT 23 (Continued).

140. LAND	186. PARTNER	234. SKUNK
141. LAUNCH	187. PEDRO	235. SKYROCKET
142. LAZY	188. PIGEONS	236. SLINGSHOT
143. LEFT	189. PLAYBOY	237. SMOKER
144. LEVEL	190. PLUS	238. SNOOPER
145. LIFEGUARD	191. PLUTO	239. SOUR
146. LIGHTS	192. POGO	240. SPLASHED
147. LINER	193. POINT	241. SPLITTING
148. LINK	194. POPEYE	242. SPOTTER
149. LOCAP	195. PORT	243. SPOOFER
150. LOST	196. POSITION	244. SQUAWK
151. LOW	197. POUNCE	245. SQUAWKING
	198. PREP CHARLIE	246. STARBOARD
152. MACK NO	199. PRONTO	247. STATE CHICKEN
153. MACK YES	200. PUNCH	248. STATE LAMB
154. MAKER	201. PURPLE	249. STATE TIGER
155. MANY		250. STATE WEAPONS
156. MAPPO	202. RAID	251. STEADY
157. MAYDAY	203. RAMROD	252. STEER
158. MEDIUM	204. RANGE	253. STOP
159. MERGED	205. RAPCAP	254. STRANGER
160. MIDDLEMAN	206. READY	255. STRANGLE
161. MIDNIGHT	207. RECCO	256. STRIKE
162. MINUS	208. RECKON	257. SUBCAP
163. MIXUP	209. RELIABLE	258. SWEEP
164. MUSHROOM	210. REPORT	259. SWEET
	211. RESCUECAP	
165. NANCY	212. RIALTO	260. TALLY-HO
166. NEGATIVE	213. RIGHT	261. TARCAP
167. NIGHTCAP	214. ROUTE	262. TARGET
168. NIGHTRECCO		263. TASP
169. NOCOP	215. SAINT BERNARD	264. TIED ON
170. NODUF	216. SALVOS	265. TIPS
171. NO JOY	217. SAPPHIRE	266. TOOL
172. NORMAL	218. SAUNTER	267. TOUCH
173. NOT	219. SAY	268. TRACK
	220. SCAN	269. TRACTORS
174. O'CLOCK	221. SCENE COMMANDER	270. TRADE
175. OCTOPUS	222. SECTOR	271. TRAILOR
176. OKAY	223. SCRAMBLE	272. TRANSPONDER
177. ON STATION	224. SCRUB	273. TRIDENT
178. ON TARGET	225. SECURITE	274. TROT
179. ON THE CLOCK	226. SEE YOU	
180. ORANGES	227. SHADS	275. UNABLE
181. ORBIT	228. SHECAT	276. UNKNOWN
182. ORBITING	229. SICK	
	230. SINGLE	277. VECTOR
183. PAN	231. SITREP	278. VERY
184. PANCAKE	232. SHIP	279. VISIBILITY
185. PARROT	233. SKIP IT	

EXHIBIT 23 (Continued).

280. WARNING RED	285. WEAPONS FREE	290. WHAT STATE
281. WARNING WHITE	286. WEAPONS TIGHT	291. WHICH TRANS-
282. WARNING YELLOW	287. WEATHER	PONDER
283. WATCH	288. WELL	
284. WAVE OFF	289. WHAT LUCK	292. YELLOW JACKET
		293. YELP

PHONETIC ALPHABET AND NUMERALS

1. ALFA	13. MIKE	24. X-RAY
2. BRAVO	14. NOVEMBER	25. YANKEE
3. CHARLIE	15. OSCAR	26. ZULU
4. DELTA	16. PAPA	27. WUN
5. ECHO	17. QUEBEC (pronounced	28. TWO
6. FOXTROT	Kay-beck)	29. THU-REE
7. GOLF	18. ROMEO	30. FO-WER
8. HOTEL	19. SIERRA	31. FI-YIV
9. INDIA	20. TANGO	32. SIX
10. JULIETT	21. UNIFORM	33. SEVEN
11. KILO	22. VICTOR	34. EIGHT
12. LIMA	23. WHISKEY	35. NI-NER
		36. ZERO

EXHIBIT 24: TRANSCRIPTION OF NAVAL AIRCRAFT RADIO AND ICS  
TRANSMISSIONS.

... \_\_\_\_ zero, over.

Pine 1, Big Tiger 102,\* how do you hear?

Roger 012, read you loud and clear and Pin. Bark 110 and Pine Bark 105 will be Pine 1 & 2 up for your control.

Roger, and 110 will be Pine 1?

110, affirmative.

Roger, 1 & 2, vector 140 for station.

And Pine Bark station will be on the 135, about twenty-five miles from South Gate. How's the weather look out there?

Oh, the overcast \_\_\_\_.

Roger - when through, level at angels twenty-two point five, and it's pretty clear above.

Roger.

\_\_\_\_\_

\_\_\_\_\_

Pine 1, this is Big Tiger \_\_\_\_ request you strangle your parrot. Pine 2, squawk normal.

Pine 2, parrot sweet - 1, go back to normal, please.

And Pine 1, verify heading 140.

Roger, passing 170 for 140.

Pine say your state now, please.

\_\_\_\_\_

Did not copy it, Pine 2 what's yours, and will you pass Pine 1's?

Pine 1, Big Tiger.

\*102 spoken as one zero two

EXHIBIT 24 (Continued).

Pine 1, Go ahead.

Roger, say your state, please.

\_\_\_\_\_ 5 plus.

Roger. Pine 2 what's your state?

Above that.

Roger.

-----  
This is Big Tiger, we're a little far from you. We're moving up there.  
You're very broken. How do you hear me?

-----  
Roger, Pine 1 vector 090 for separation -- Pine 2 starboard 180 for separation

Pine 1 090

Pine 2 180

Pine 1 & 2 in the event of no communications for any 1 minute period, attempt contact Big Tiger Button 8. If no joy, attempt contact South Gate, proceed overhead South Gate, over

Pine 1 copy.

Pine 2, you copy lost comm?

That's affirmative.

Pine 1, you want to be the first shoot?

Roger.

Pine 1, Big Tiger, I'll make the short one, uh, the first one at about twenty miles separation to get started. Then we'll make it a little more after that.

Roger

Pine 2, port 050 as the bogey, over.

\_\_\_\_\_ 050 \_\_\_\_-.

Pine 1, starboard 230 for a bogey, over.

EXHIBIT 24 (Continued).

Pine 1, 230

Pine 2, your bogey 224 at seven-teen (should have said Pine 1)

1, roger

1, your bogey 230 at eighteen

1, your bogey, single, altitude medium

Roger

1, when steady (on heading 230) your bogey's at 050, indicating point 6 (speed mach 0.6), out

1, speed and angles as desired, check your switches safe.

1, switche-s safe.

1, your bogey 226 at nineteen

1, your bogey 225, seventeen

1, your bogey 224, eleven, Break, port 220

Steady 220

Roger, your bogey 223 at ten

Bogey now 225 at 8. 1, Starboard 230

1, 230

1, your bogey now 230 at 5

Tally!

Roger tallyho, your bogey now 230 at 2

Bogey now coming 230 about 1

1, your bogey should be passing your left wing. Break away 230

-----  
1, you were very broken.

Skip it.

Roger, skip it. Continue 230. 2, continue 250.

-----  
Roger, your break away pigeons were 318 at thirty-six.

1, what state?

EXHIBIT 24 (Continued).

Pine 1, Big Tiger bears 257, twenty four miles from you. Big Tiger's level at twenty-two point five.

Roger

2, what state?

Thirteen point four, approximately.

Roger, and 1, your state?

1, affirmative.

2, starboard 240 as the bogey, over

2, starboard 240.

1, port 060 for the bogey, over

060

1, your bogey 057, twenty-five, out

1, same bogey information as before, or do you wish any repeated?

\_\_\_\_\_  
Roger, check Switches safe.

\_\_\_\_\_  
1, your bogey now 058, thirty-one

1, is your dolly up?

\_\_\_\_\_  
1, you were broken - understand your dolly is up?

1, affirm.

Roger, request you say your dolly information.

\_\_\_\_\_  
1, show bogey 062, thirty

\_\_\_\_\_

EXHIBIT 24 (Continued).

Roger 060, and say command head

\_\_\_\_\_

This is 012, understand no command head

\_\_\_\_\_

( "Arm Warning"?)

Roger, bogey 066, twenty-five. Are you receiving an RM-1 indication?

\_\_\_\_\_

Roger

1, your bogey 066, nineteen, command heading should be 060. Do you concur?

\_\_\_\_\_ at fifteen miles.

\_\_\_\_\_ your heading 240

\_\_\_\_\_

Roger Judy

\_\_\_\_\_ 2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Roger, your break away 060

Breakaway pigeons 316 at thirty-seven

2, continue 240

\_\_\_\_\_

2, is your dolly working?

Affirmative

Roger, we'll try to hook you up on this run

1, what state?

Twelve point three

Roger, - 2?

Twelve point three

1, come port 230 as the bogey, over  
230

2, starboard 050 for bogey, over

Starboard 050

2, your bogey 247, twenty-three

2, your bogey single, altitude medium, out

2, when steady your bogey heads 230, indicating point 7, out

2, speed and angels as desired, check your switches safe, over

Switches safe

2, your bogey 050, twenty-eight

2, your bogey 053, at thirty

2, this is Big Tiger, do you have any dolly information, over?

2 has no dolly information

Roger 2, if you get any dolly information, would you please pass it?

2, your bogey is 050 at twenty-four  
("Arm Warn"?)

2, I have an RM-1 now

Roger, do you have a command head or a range and bearing?

Standby one

Your bogey's now 049, sixteen

2, your bogey 048, fourteen

Roger 2, I have a Judy

EXHIBIT 24 (Continued).

Roger Judy  
And command heading of 047  
This is 012, concur

\_\_\_\_\_  
Understand simulated \_\_\_\_\_?

\_\_\_\_\_  
Roger, skip it, break away will be 060  
Roger, coming to 060  
Break away pigeons 349, thirty-four  
1, what state?  
Eleven point five  
Roger, 2?  
2 is Twelve point two  
Roger two, we'd like to try a machine drive arm 2 this time if you could.  
Roger, \_\_\_\_\_  
We'll get you a way point  
1, Big Tiger, do you have Big Tiger on your 300, seventeen miles, southbound?

\_\_\_\_\_  
2, do you hold your way point on your 060 at thirty?  
2, affirmative  
Roger  
Roger, now 068?  
Affirmative  
Pine 2, this is Big Tiger, port 030 as the bogey, over  
Pine 2, coming port to 030. And Pine 2 is the target?  
Disregard, Pine 1, come port 030  
Pine 1 to 030  
And Pine 2, starboard 210 for a bogey, over  
Pine 2, roger.  
Pine 2, your bogey 215, twenty-five  
Pine 2 has another target  
That's affirm; we're taking you from way point to your assignment  
Pine 2, your bogey now 1....your bogey now 0224, thirty-two and you should  
have an orbit light just going out.  
This is Pine 2, arm 1  
Roger  
And a command heading of 090, thirty-two  
This is 012, concur. \_\_\_\_\_ arm 2.  
And it's still on normal.  
This is 012, roger. It should take it a second to catch

\_\_\_\_\_  
\_\_\_\_\_  
Judy, 220 at twenty

EXHIBIT 24 (Continued).

Roger

2, radio check  
Loud and clear

And a simulated Fox (Fire ?) 1, and let's take a breakaway and get situated  
as a bogey

Roger, breakaway for 2 will be 150

Roger, 2's coming to 150

And 1 breakaway 030

1 is steady

Roger, your breakaway pigeons are 356, twenty-nine

This is 012, concur

And 1, Big Tiger are you copying your way point

1, standby

1, negative; we do have \_\_\_\_\_ and a command heading and airspeed. 030

Roger it should be 030 for a command heading. Should have just changed to 020

2, port 020 as the bogey, over

2, coming port 020 as the bogey

1, starboard 160 for bogey, over

1, your bogey 178, twenty-four

1, your bogey 177, twenty-seven

1, your bogey 174, twenty-eight

1, your bogey 175, twenty-seven

Bogey now 176, twenty-5

Bogey now 179, twenty

Bogey now 180, eighteen Break, hard starboard 190

1, has contact, appears to be about fifteen miles

Roger that's your bogey

Judy

Roger Judy

1, understand Fox 2, your breakaway 190

2, your breakaway 350, and 1 or 2, did you copy?

Pine 1, Big Tiger

Go ahead

Roger, your breakaway 190, did you copy?

1, your breakaway pigeons were 314 at twenty-7

2, port 210 as the bogey, over

Roger

1, starboard 030 for a bogey, over

1, starboard 030

2, did you copy port 210?

Affirmative, coming to 210

EXHIBIT 24 (Continued).

Roger. 1, your bogey 025 at twenty-8  
1, roger, and be advised you're breaking up again  
Roger, we're coming back to you now  
1, your bogey 014, thirty-1  
1, steady 360 ("Stop your turn and steady up on heading 360)  
Roger  
1, your bogey 012, thirty-1  
1, steady  
Roger steady, your bogey 012, twenty-8  
1, your bogey 010, twenty-u, just completing a port turn  
1, your bogey 009, twenty-6  
1, your bogey 009, twenty-4  
1, your bogey 009, twenty-2  
1, your bogey 009, nineteen  
1 has contact at fifteen miles  
Roger, that's your bogey, heading 210

---

This is 012, your bogey now 003, fourteen  
Have a Judy  
Roger Judy  
1, steady up. \_\_\_\_\_ ten miles.

---

Lost contact  
Roger, your bogey 335, 7  
Bogey now 324, 7, Break, come port 270  
Bogey now 307, 6. Come hard port 210  
Bogey now 286 at 7, moving away  
Bogey now 272 at 8  
Bogey now 257 at 8  
Judy  
Roger Judy  
1, skip it.  
Roger skip it, your breakaway 030  
1, roger, 030  
1, your breakaway pigeons are 323 at twenty-2 miles  
1, what state?  
1, state ten point four  
2, what state?  
2, state ten point 1  
Roger  
Understand 2 is the target this time  
Roger, 2 will be the target this time  
\_\_\_\_\_ we have no TACAN.

---

Roger, understand negative TACAN. And who's that - 1 or 2?

That's for Pine Bark 1

Roger 1

And \_\_\_\_\_

That's affirmative

O.K. I'll try to check you out when we \_\_\_\_\_.

About forty degrees

OK, I didn't really know, but I think my \_\_\_\_\_ are in Stabilization.

2, Big Tiger, you receiving the way point excitement?

2, that's affirmative. 192 at twenty-1

012, concur

And 1 is steady 020

Roger steady

1 is now level at eighteen point five and completely VFR down here.

Roger; 2 say angels

Angels nineteen point five

Roger, did you copy 1?

2 is going lower

1, Big Tiger, starboard 180 as the bogey, over

1, starboard 180

2, port 060 for the bogey, over

2, port 060 to complete intercept

2, your bogey 026 at thirty-2

And 2, Big Tiger, could I track cat's eye this time?

See you

2, Big Tiger, could I track cat's eye this time?

Say again?

Roger, could I track cat's eye this time?

Certainly

Roger, your bogey now 026, thirty-6

Roger

\_\_\_\_\_  
Pine 2, steady 060

Roger

Pine 1, steady 180

Pine 2, your bogey 028, thirty-2

2, your bogey 029, twenty-9

2, continue 060

2, your bogey 028, twenty-8

2, your bogey 027, twenty-5

Roger! Contact! Two Five at twenty-2

2, that's your bogey, heading 180

Roger

2, port, 070

Port, 040

2, your bogey 027, twenty

EXHIBIT 24 (Continued).

Roger steady, your bogey now 028, at seventeen  
Show him 020 at \_\_\_\_\_  
Roger come hard port 340  
340?  
Roger  
Wilco!  
Your bogey now 018, sixteen  
Your bogey now 018, thirteen  
Your bogey 026, ten  
Your bogey 030, seven  
Bogey 050, 5, mark starboard 180, bogey head  
Bogey 061, 3  
Bogey 071, 2  
Bogey 148, 1  
Bogey 150, 1  
Bogey 165, 1  
And that ought to be about the finish  
Roger, call final position, please  
Roger, we were about a mile, six o'clock  
Roger, your breakaway 360  
Roger 360. That was a pretty good run  
Thank you. Your breakaway pigeons 336 at thirty-6 and say state  
State about nine point 7  
Roger  
And 2, Big Tiger, how's the weather out there where you are?

\_\_\_\_\_  
Roger.  
1, your pigeons are now 339 at forty-5  
South Gate, Over.  
This is 012, Roger - he still . . . . .  
I. AND JIM, STAGE WANTS US TO COME UP TACTICAL SECURE -- I DON'T KNOW WHAT FOR.  
Affirmative  
And Stage Coach, 012.  
I. AND I'VE CHECKED IN ON PIRAZ.  
012, South Gate  
I. OK, \_\_\_\_\_, CAN WE HEAD 180?  
I. OK  
And  
xxx Pine 2, Big Tiger understand you are receiving \_\_\_\_\_ this time?  
(buzz buzz buzz)  
Pine 1, Big Tiger, I am unable to read Pine 2 - can you pass?  
This is Pine 2 (broken) how do you read me now?  
Big Tiger, do you have \_\_\_\_\_ any bogey dope for us?  
Uh, Roger Pine 2, come starboard a long ways, 340.  
Coming starboard 340  
And 2's level eighteen 5 (18,500 feet) (Angels eighteen point five")  
Roger 2 and starboard 340. 1, port 160.  
1, port to 160

EXHIBIT 24 (Continued).

1, your bogey 168, twenty-five.  
1, roger.  
1, check your switches safe.  
1, switches safe, (state) twenty-three ninety-seven  
1, your bogdy 171, twenty-six.  
1, your bogey 175, twenty-five  
1, your bogey 175, twenty-three  
And 2's steady 340  
Roger steady  
1, your bogey 173, twenty-two  
1, is steady 160  
Roger steady, starboard 190  
1, roger  
1, your bogey 172, twenty-one  
1, hard port 150  
1, roger  
1, your bogey 173, fifteen  
1, your bogey 172, thirteen  
1, your bogey 170, eleven/\_\_\_\_\_ cause you have the 180.\*  
1 has the duty/coming that direction as far (high?) as I can\*  
OK/Let's not make this a \_\_\_\_\_.\*  
Roger continue to 150/I'm not sure I can hold it though if the weather../Going  
to 150/OK\*  
They're about.. uh/1, your bogey 180/fifteen miles out on your port wing/  
correction, 180, five.\*  
1, your bogey 200, five  
1, hard starboard 340, bogey heading  
I got him  
1, your bogey 211, six  
1, your bogey 230, five  
1, your bogey 270, three  
1, your bogey 290, two  
1, your bogey 320, two  
1, your bogey 338, two and a half  
1, show your bogey on the nose, two miles  
1, your bogey 340, two  
1, Roger, you want to break away and set up a new one?  
Roger, break away. Be advised Big Tiger is on your 272, eleven miles. Your  
break away 160.  
1, roger your ranges were a little long this time.  
This is 012, roger, could you say final position, please?  
Roger, we were six o'clock at about four miles and your contacts originally  
were about four miles difference in distance I was indicating on the (UCR?-2)  
012, Roger  
This is Pine 2, I had the ranges right on  
Did you?  
And Big Tiger, shifting my weapons.  
Roger/About a mile behind

\*----/----

Transmissions from 2 groups overriding  
each other on the same frequency

EXHIBIT 24 (Continued).

2, what state?

Pine 2, Big Tiger, say state?

Pine 2, state 8 point oh.

Roger, Pine 1?

Pine 1, 8 point 6

Roger

1 from 2

go ahead

I. WHEN'S OUR E-A, OUR NEW E-A-C OF TWENTY THIRTY-SEVEN.....RECOVERY  
OF TWENTY FORTY-FIVE.

Pine 1, Big Tiger, port to 360 has the bogey

1, port to 360

Pine 2, Big Tiger, Starboard 160 for a bogey

2, coming starboard to 160

2, your bogey 169, twenty-eight

Say Pine 1 heading again

Roger Pine 2, 3 - correction, Pine 1 is 360

Pine 1, Roger

And Pine 2 is 160.

I. COMPARE WITH YOUR TIME IF THE LAUNCH GOES AT TWENTY FORTY-FIVE?

I. I'M CHECKING THE POSITION, OVER.

Pine Bark, this is Big Tiger, we're getting your Charlie time right now

1, roger.

2, your bogey 175, thirty-eight.

I. DID YOU CALL MARSHAL, .. CANCEL ...?

I. I'LL CALL.

I. DO YOU WANT US TO CALL MARSHAL TO GET THE MARSHAL INFO FOR YOUR PINES?

I. YEAH, CAN YOU?

I. OK. THAT'S 110 AND 105, RIGHT?

I. RIGHT.

... 179, twenty-nine/OK

2 is steady 160

Roger, you bogey is 182, twenty-seven, starboard 180

180, roger

2, your bogey 180, twenty-three

2, your bogey 180, nineteen, port 150

And 2 has a contact, 185 at eighteen

That's your bogey, heading 360

Roger, got him

Roger, goody

-----  
Very garbled, say again

Pine 1, radio check

1, read you loud and clear

-----  
-----

EXHIBIT 24 (Continued).

This is Big Tiger, Pine 1, read you loud and clear.

-----  
Roger Dog 1, you ready to break away?

-----  
That's affirm, Big Tiger, did you come up with that approach time for us?  
We're still working on getting it.  
Say pigeons. 2, I'm starting a port turn -- join. ("Join up with me")  
Roger  
Roger, your pigeons are 318 at twenty-four.  
And 110, your time is 50, over.  
Roger, copied.

EXHIBIT 25: WALKER AND BLACK FLIGHT PHRASES.

- 1) The 20 five-syllable flight phrases were taken from: Walker, Crayton; Black, John W., The Intrinsic Intensity of Oral Phrases (The Ohio State University Research Foundation, Columbus, Ohio, and the U. S. Naval School of Aviation Medicine, 1950), p. 9-14.
- 2) These phrases are equated for mean intensity and duration.
- 3) Each order is a different randomization of the same 20 five-syllable phrases.
- 4) There is a total of six orders.
  1. Speed is kept constant
  2. You have no power
  3. Rough terrain below
  4. Slip close to the ground
  5. The glide is broken
  6. Head into the course
  7. Release the pressure
  8. Practice these landings
  9. Dive down to a field
  10. Turn into the wind
  11. Try some circle shots
  12. Drop off to one side
  13. Unlock the tail wheel
  14. The brakes can be used
  15. Pull the stick back more
  16. Reset the throttle
  17. Always keep flying
  18. The plane is climbing
  19. Vary your pattern
  20. You press right rudder
  1. Rough terrain below
  2. You press right rudder
  3. The glide is broken
  4. Slip close to the ground
  5. The brakes can be used
  6. Always keep flying
  7. Practice these landings
  8. Drop off to one side
  9. Unlock the tail wheel
  10. Pull the stick back more
  11. Reset the throttle
  12. Try some circle shots
  13. The plane is climbing
  14. Vary your pattern
  15. Speed is kept constant
  16. You have no power
  17. Head into the course
  18. Turn into the wind
  19. Dive down to a field
  20. Release the pressure

## EXPLANATION OF CODING IN EXHIBIT 26:

Symbols appearing in columns 2, 4 and 6 denote word-frequency counts (occurrences per million words), from Thorndike, E. L. and Lorge, I. (1952) and inclusion in one or more of the five word tests used in the study, as follows.

First symbol (occurrences per million words):

AA = at least 100 occurrences/million words

A = between 50 and 100 occurrences

Numerals 1 through 49: designated number of occurrences under 50

— = not counted.

The second through the sixth symbols in these columns indicate that the word is included in one or more of the following word lists:

### Letter = Word List

P = Egan's Phonetically Balanced Words

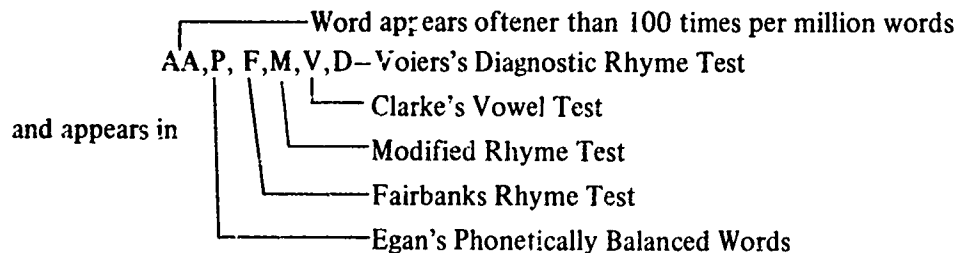
F = Fairbanks Rhyme Test

M = Modified Rhyme Test of House et al. as modified by Kreul et al.

V = Clarke's Vowel Test

D = Voiers's Diagnostic Rhyme Test

Thus the word "bit" as it appears on the list may be identified as follows:



**EXHIBIT 26: AIRCRAFT COMMUNICATION WORD LIST.**  
**A. SINGLE WORDS**

a	AA	bank(ed)	AA	boot	37
ABORT(ING)	-	bar	A,P	bore	A,F
add	AA,Z	BARCAP	-	born	AA,F
AFFIRM	10	bare	A	botch(ed)	-
AFFIRMATIVE	3	barge	12,P	both	AA
aft	4	barn	45,P	bounce(d)	10,P
aid(s)	A,P	base(d)	AA,P	bound	A,V
aim(ed)	A,P	bat	19,P,M,D	BOWWAVE	-
air	AA,P	BATTERY	19	brace	17,P
AIRBORNE	-	batch	3	brakes	23
aisle	12	bay	AA,P	branch	AA
ALFA	-	be	AA	BRAVO	1
all	AA,P	beach(ed)	A,M	break	AA
alley	13	beam	42,P,M	bridge	AA
alp	-	beat(s)	AA,F,M,D	brief	A
ALTITUDE	14	been	AA	bright	A'
am	AA,P	BELLHOP	-	brim	13
an	AA	<u>bend(-t)</u>	48,F,M,V,D	bring	A'
ANCHORED	26	best	AA,P,F,M	brink	8
ANYCAP	-	bet	23,P,V	brisk	9
and	AA,P	big	AA,P,F,M	broad	A,V
ANGELS	47	bind	39,P,V	broiled	9
ANGLE	30	bird(s)	-	broke	A
any	AA	bit	AA,V	brown	AA
APPROACH	A	black	AA,P,F,M,V,D	BROWNIE	6
apt	22,P	blade(s)	AA,P	budge(d)	4,P
are(-)	9,P	blare	32	build	AA
arch(ed)	34,P	blast	2	bulge	5
are(n't)	AA,P	blaze	31	BULLMOOSE	-
arid	AA	bleak	42	bum	6
ARK	7	bleed	9	bury	-
arm(ed)(s)	AA,P	blind	16	burn(ed)(t)	AA
as	AA,P	blow	A,P	burst(s)	A
ask(ed)(s)	AA,P	blob	AA	bus	9,P,M
ASPRO	-	block	-	bust	13,P,F,M
ASSUME	A	blow(n)	A	BUSTER	-
at	AA,P,V	blue	AA	but	AA,P,M
AUTOCAT	-	bluff	AA	buzz(ed)	16,P
AWAY	AA	blur(red)	12,P	by	AA,P
aye	16	board(s)	8	bye	1
BABS	-	boat(s)	AA		
back	AA,P,F,M	bogged)(gy)	AA,V	cab	15,P
bad	AA,P,M,V,D	BOGEY	9,P	cage	30,P,F
bagged)	AA	bolts	27,P	call(ed)	AA,V
ball	AA,P,V	bomb(s)	13,D	calm(ed)	A
ban	2,M	book	AA,P,F,M	came	AA,F,M
band	A,V	boom	19	camp	AA,P
bang	14,F,M	boost	2,P	can(-t)	A
				cap	

EXHIBIT 26 (Continued).

cape	34,P,M	clank	2	COVER	AA
CAPREP	-	clap	22	cowl	5,V
car(s)	AA,P	CLARA	12	crack(ed)	48,P
card	A	clash	12,P	craft	21
care	AA,D	clasp	27	cram	6
carve	26,P	class	AA,P	cramp(t)	8
cat	A,P	clean(ed)	AA	crane	9
catch	AA,P	clear(ed)	AA	crank	8
cause(d)	AA	clew	2,P	crash(ed)	34,P
CAUTION	15	click	10,P	crate	7,P
CAVU	-	cliff(s)	38,P	crawl	31
cease	A	climb	A,P	creak	9
cell(s)	A	clinch	3	creep	36
chaff	7,P	cling	24,P	crest(s)	18
chain	A,P	clip	16,P	crew(s)	46,P
chance	AA,P	cloak	28,P	crisp	15
change(d)	AA,P	clock(ed)	A	crook	10
chap	14,P	clog(ged)	4,P	cross(ed)	AA
charge(d)	AA,P	close(d)	AA,P	(ing)	
CHARLIE	42	cloud(s)	AA,P	crow	37
chart(s)	15,P	clue(s)	4,P	crowd	AA,P
chase(d)	48	clump(ed)	9	crown	A
chat	12,P	clung	18	crude	17,P
CHERUBS	-	clutch	21,P	cruise	10
check(ed)	AA,P	CLUTTER	2	cub	11,P,M
chew	14,P,D	coach	42	cube	9
chick(s)	15	coarse	28	cue(d)	3,P
chief	AA	coast	A,P	curb	14,P
chill(ed)	43,P	coax(ed)	10,P	curl	45
chin	27	COCKROACH	1	curve(s)	36,P
chip	17,P	code	21,P		
chirp	8	coil	13,F,M,V		
chock(s)	3,D	cold	AA,F,M		
choice	A	colt	21		
choke(d)	27	cone(s)	AA,P		
choose	A,P,D	CONDITION	AA		
chop(per)	29,P,D	cone	7		
chose	A,P	CONFUSED	25		
chuck	9	CONTACT	31		
chuy	1	CONTINUE	AA		
chum	4	cope	10		
chunk	3,P	core	7		
churn(ed)	4	cork	11,P		
chute(s)	2	cost	AA,P		
CIGAR	16	cough(ed)	18		
cinch	1	could	AA		
cite	1	count	AA		
clamp(ed)	10	course	AA,P		
clancy	-	cove	5		

EXHIBIT 26 (Continued).

cut(s)	AA, P	down	AA, V	end	AA, P
cycle(d)	8	drag(ged)	A	ENGAGE	A
DADCAP	-	draw(n)	AA	enter	AA
damp	27	dread	45	entry	17
DANGER	AA	drench(ed)	7	equal	A
dark	AA, F, M	dried-(s)	26	error	36
darn	12, P	drifts(s)	36	ESTIMATE	40
dart	33, P	drink(s)	AA	even	AA
dash	A, P	drive	AA	ever	AA
date(s)	AA, F	drizzle	1	EVERGREEN	9
dawn(ed)	A, V	drone	7	eye	AA, P
day	AA, P, F, M	drop(ped)(s)	AA, P	face	AA
DAYRECCO	-	drove	A	fact(s)	AA, P
dead	AA, P	drug	24, P	fade(s)(d)	41, P
deaf	19, P	drum	40	fag(ged)	3
deal	AA, F	dry	AA	fail(s)	AA, F, V
DECIMAL	1	dual	2	faint	A
deck	A, P, D	duck(ed)	49, F, M	fair	AA, V
DECOY	3	duct	1	fall	AA, P
deep	AA, P	DUCKBUTT	-	false	A
DELTA	8	dud(s)	M	FAMISHED	4
dense	19, D	due	AA	fan	38, P, D
DETACH	8	dug	26, M	far	AA, P, V
dew	30	dull(ed)	48, P, M, V	fast	AA, P, F, D
dial(s)	8	dumb	34, P, V	fault	A, D
did(n't)	AA, P, F, M, D	DUMBO	-	FEAR	AA, V
die	AA	dump(ed)	10, F	feat	13, M
differ	30	during	AA	fed	41, P, F, M
digit	-	dusk	14, F, M	feel(s)	AA, P, F, M, D
dim(ed)	37, M	dust	A	feet	AA, P
dime	11, P, V	duty	AA	fell	AA, P, F, V
dip(s)	34, P, F, M, D	dwel(l(ed))(s)	44	felt	AA
disk	8	dye	23	fence	A, D
ditch(ed)	28, P	each	AA, P	FERRRET	2
ditching	28, P	eager	39	few	AA, P
dive	21, P	eagle	38	field(s)	AA
DIVERT	11	early	AA	fifth	A, P
do	AA	earth	AA, P	fifty	AA
dodge(d)	16, P	ease(d)	A, P	fight	AA, F, V
does(n't)	AA	east	AA	file	43, F, V
dog	AA, P	easy	AA	fill(ed)	AA, P, F, M, V
DOLLY	8	eat	AA, P, V	film	31
dome	15, V	echo	42	fin	6, P, M, D
done	AA, P	edge	AA, P	FINAL	A
don't	AA	eight	AA	find	AA, P
door(s)	AA	ELEVATOR	15	fine	AA, P, F
dot(s)	38, P, D	else	AA, P	fire	AA, F
doubt	AA, P	EMERGENCY	19	firm	A
dove	19, P				

## EXHIBIT 26 (Continued).

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first	AA	frame	A	good	AA,P
fit	AA,P,F,M,V,D	free(d)	AA	GOODYEAR	1
five	AA,P	freeze	32,P	goof(ed)	-
fix	A	friend(s)	AA	goose	45,P,D
FI-YIV	-	FRIENDLY	A	got	AA,P,F,M,V,D
flag	A,P	fringe	17	grab(s)	18,P
flair	1	from	AA	grade	44,P
flame	A,P	front	AA,P	grand	A
flank(ed)	15,P	frost	41	GRANDSLAM	-
flap	16,P	froze(n)	5	grant	AA
flare	10,P	fuel(ed)	21	GRAPHIC	3
flash(ed)	A,P	full	AA	grasp(ed)	36
flat	A	fume(s)	8,P	grass	AA
flaw	6	funny	A	gray	AA,P
fled	35	fuse	7,P	graze(d)	16
fleet	A,P	gab	P,D	grease	16
flew	A	GADGET	2	great	AA
flick	4,P	gage	2,P	green	AA
fling	15,P	gain	AA,F	greet	A,P
flip(ped)	3,P	gale(s)	15,M	grew	AA,P
float	A,P	game(s)	AA,F,M	grey	19
flock	44	gang	25,P,F,M	grid	-
flood	A,P	gap(s)	17,P	grim	22
floor	AA	gas(ed)	A,P	grip	35
flop	5,P	gate	AA,P,F,V	gripe	10,P
flow(ed)(s)	AA	gauge	5	group(s)	AA,P
(n)		gave	AA	grove(s)	31,P
flung	31	gay	A	grow	AA
flush(ed)	23,P	gaze	A	guard	AA
fly	AA	gear(s)	9	guess	AA,P
foam(ed)	21,P	GEIGER	-	GUESSER	-
foe	23,P	GERONIMO	-	guest	A,D
fog(s)(gy)	18	get	AA,P,F,V	guide	AA
fold	A,P,M	giant	A	gulch	3
foot	AA,P,V	gird	6	gulf	33
for	AA,P,V	girl	AA	gull	5,P
force(d)	AA,P	give	AA,P	gun(s)	
fore	11	glad	AA	gust	6,M
fork(ed)	31	glare	26	GYRO	-
form(s)	AA,P	glass	AA		
forth	AA,P	glaze	9	hack	7,P
forty	A	gleam	35	had(n't)	AA,P,V
foul	27,V	glide	24	haft	-
fould	-	gloom	18	hail	40,V
found	AA	glove	43,P	half-ve	AA
four	AA	glow	A	halt	29
fourth	A	go(ne)	AA,D	hand	AA
FO-WER	-	goal	21	hang	AA,M,V
FOX	25	GOBLIN	14	hard	AA
FOXTROT	-	GOLF	26,P	harm	A

EXHIBIT 26 (Continued).

harsh	17	HOTEL	A	keep(s)(t)	AA,P,D
has	AA	hours	AA	KEEPER	23
hatch(ed)	19,P	how('d)	AA,P	kill	AA,P,F,M
hate	A,P,F	howl	34,P,V	KILO	-
haul	21	hue	12	kind	AA,P
have(n't)	AA,P	huge	A	kink	1
hawk(s)	22	HUGO	5	knife	A,P
haze,-y	5	huh	3	knob	7
he('d)('ll)	-	hull	8,P	knock	A,D
('s)	AA	hum	20,P,V	knot	26
head(ing)	AA,V	hump	5,P	know	AA
heap	46,P,M	hunch	5,P	lace	32,M
hear	AA,P,M	hung	A	lack	A,F
heat	AA,P,F,M,V	hunt	A,P	lag	9,P
heave	18,M	HUNTSMAN	6	laid(-n)	AA,V
HECKLERS	-	hurl	20,P	lakes	AA
hedge	32,P	hurt	AA,P,V	lame	29,M,V
heed	21,P,V	HUSH	26,P	lamp(s)	A,D
held	AA			lance	16
hell	31	ice(d)	AA,P	land(s)	AA
helm	13	I('d)('ll)		lane	32,M
HELOT	1	('m)	AA	lap	36,P,D
help(ed)	AA	IDENT	-	lapse(d)	8
hen	49,F,M	IDENTIFY	20	large	AA
her(s)	AA	ill	AA	lash	22,P
here	AA	in	AA,P	last	AA,P,F,V
hex(ed)	-	INDIA	46	latch(ed)	8,P
hid(e)	A,P,F,V	INTERFERENCE	11	launch(ed)	18
high	AA,P	INTRUDERS	6	lay	AA,P,M,V
hight	5	isle	28,P	LAZY	25
hill(s)	AA,P,M,V	isn't	AA	lead	AA
hind	26	it('d)(s)	AA,V	leak	8,D
his	AA,P	jab	2,P,D	leap(ed)	A,D
hiss	16,P	jam	16,P	least	AA,V
hit(s)	A,P,F,M,V,D	jerk(ed)	18	leave(s)	AA,P
hitch	9,P	jet	9	led	AA,P,F,M,V
ho	16	jinx	-	lee	28,V
hoist	10	joy	4	left	AA,P
hold(s)(ing)	AA,F,M	join(ed)(s)	AA	leg	AA,P
hole(s)	AA,F,V	joint	36	less	AA,P
home(s)	AA,V	jolt	5,P	let(s)	AA,F,V
HOMER	-	joy	AA	LEVEL	A
hood	21,P,V	judge(d)	AA,P	lie	AA
hook	47,P,F,M	JUDY	9	LIFEGUARD	-
hop	35,F,M,D	JULIETT	7	lift	AA
hope(d)	AA	jump	A,F	light(s)	AA,F,V
horn	A,F	just	AA,F,M	like(d)	AA,V
HOSTILE	20	jut	6	LIMA	2
hot	AA,P,F,M,V			limb	38,V

EXHIBIT 26 (Continued).

line(d) (s)	AA,P	meet (s) (-t)	AA,V	neck	AA,P,D
LINER	4	melt (ed) (s)	A	NEGATIVE	10
link(ed)	24,F	men	AA,F,M	need (n't)	AA,P,D
lip	AA,P,F,M,D	merge(d)	6,P	nest	A,P,F,M
list	A,V	mesh	6,P	net	A,P,V,D
lit	16,P,V	mess	17,V	new	AA,P
live	AA	mid	11	next	AA,P
load(s)	A,V,D	MIDDLEMAN	2	nice	AA,P
lob (bed)	-	MIDNIGHT	A	night	AA,P,F,V
lobe	2	midst	44	NIGHTCAP	2
LOCAP	-	might	AA,F,V	NIGHTRECCO	-
lock(ed)	A,F,V,D	mike	-	nil	-
lodge	48	mil	1	nine(r)	AA,P,F
loft	8	mild	32	ninth	22,P
lone	22	mile(s)	AA	nip	6,P,D
long	AA,D	mind	AA	no	AA,P
look(ed)	AA,P,F,M,V	MINUS	2	NOCOP	-
loom(ed)	21,V	mirk	-	NODUB	-
loop(ed) (s)	15	miss(ed)	AA,V	noise	A
loose	A,P	mist	29,P	none	AA
lose(-t)	AA,P,V	mix(ed)	A	noon	A,F,D
loss	AA,P	MIXUP	-	nor	AA
lot	AA,F,M,V,D	mock	31,F	norm	-
loud	A,P,V	mode	23,P	NORMAL	41
low	AA,P,V,D	moist	19	north	AA
luck	46,F	moon	AA,F,D	not	AA,P,F,M,V
lull	11	mop	5,P,F,M	notch(ed)	11,P
lunge	2,P	more	AA,F,V	note(s)	AA,P,V,D
lurch(ed)	3	morse	7	NOVEMBER	A
lurk	15	most	AA,P	now	AA
		mound	17	nudge(d)	2,P
main	A,F	mount	AA	null(ed)	1
make(-de)	AA,P,F	mouth	AA,P	numb(ed)	5
MAKER	27	move(d) (s)	AA,P	nurse(d)	A
many	AA	mow	6,P	O'CLOCK	A
map	A,P,M	muck	AA	OCTOPUS	2
MAPPO	-	mud	5,P	odd	38,P
mark(ed)	AA,F,M	murk	47,P	of	AA
marsh	16	mush	-	off	AA,P
mask	17	MUSHROOM	2,P	oh	AA
mass	A,P,M	must	10	oil	AA,M
mat	18,M,V	my	AA,F,M	OKAY	3
match	A		AA,P	old	AA
may	AA,P,F,M	name	AA,F,M	on	AA,P
MAYDAY	-	NANCY	15	once	AA
maze	6,P	near	AA	one	AA
me	AA,P	neat	29,P,F,M	or	AA,P
mean	AA	'neath	-	ORANGES	A
meant	A			ORBIT (ING)	10
MEDIUM	23				

EXHIBIT 26 (Continued).

OSCAR	2	plan(ned)	AA	quick	A,P
other	AA	plane	A	quiet	A
ought (-to)	AA,P	plant	AA	quit	49
our	AA,P	plate	A	quite	AA
out(er)	23,P,V	PLAYBOY	-	rack(ed)	29,P
over	AA	please(d)	AA,P	raft	7,P
own	AA,P	plight	11	<u>raid</u>	11,P,V
		plod	5,P	rain	AA,F
pace(d)	A,M	plop(ed)	-	raise(d)	AA,P
pack	A,P,F	plot	36	ram(med)	16
pad	17,P,M	plow(ed)	35,P	ramp	1,P,D
paint	AA	plunk	-	RAMROD	1
pair	AA,V	<u>plus</u>	10,P	ran	AA
pale	A,F,M,V	plush	1,P	rang	25,F,M
PAN	A,P,M,V,D	PLUTO	3	<u>range(d)</u>	A,P
PANCAKE	6	pod	3,P	rank	A
PAPA	34	FOGO	-	rap	10,P,D
par	5	<u>point</u>	AA	RAPCAP	-
park(ed)(s)	A,P,F,M	fole	A,V	rare	43
PARROT	9	pond	30,P,D	rate	AA,P,F,M,V
part(s)	AA,P	pool	34,V,D	raw	46,P,F,M,D
PARTNER	32	poor	AA,V	ray	A,P,M
pass	AA,P,M	pop(ped)	21,F,M,V	reach(ed)	AA,P
past	AA,P,F	POPEYE	-	read(past)	AA
patch(ed)	34,P	pore	8	READY	AA
path(s)	AA,P,M	<u>port</u>	A	real	AA,P
pause(d)	A	POSITION	AA	rear	A,P
pave(d)	14,M	post	AA	RECCO	-
pay	AA,F,M,V	POUNCE	6,P	reck(ed)	2
peak(ei)	28,M,D	prang(ed)	-	RECKON	21
peal	9,M	press(ed)	AA,P	red	AA,F,M,V
PEDRO	4	prey	28	reef	6,P
peg(ged)	9,P,D	prime(d)	17,P	reel(ed)	19,F,M
per	A	prior	15	RELIABLE	10
phase(d)	15,P	prone	6	REPORT	AA
pick(ed)	AA,P,F,M	PRONTO	-	RESCUECAP	-
piece(d)	AA	prop(s)	-	RIALTO	-
PIGEONS	34,P	prowl	7	rich	AA
pile	A,P,F,V	puff	28,P,M	rid	33,P,F,V,D
pin(ned)	43,F,M,V	pull(ed)(s)	AA	ride	AA,P,F
pinched	20	pump(ed)	29,P,F	ridge	31,P
pine	A	<u>punch(ed)</u>	17	<u>right</u>	AA,F,V
ping		punt	P	rim	12
pink	A,P,F	purge(d)	6,P	ring	AA
pip	M	PURPLE	37	rip(ped)	19,P,F,M,D
pit	29,P,M,V	purr(ed)	6	rise(s)	AA,P
pitch(ed)	43,P	push(ed)	A	risk(ed)	40,P
place(d)	AA	put	AA,P	road	AA,V,D
plain	AA	QUEBEC	7	roar	A,P

EXHIBIT 26 (Continued).

roll(ed)	AA,P	send(s) (-t)	AA,F,M	sky(-ies)	AA,P
ROMEO	5	sense	AA,P	SKYROCKET	-
roof	AA	serf	4	slab	7,P
room	AA	set	AA,P,F,V	slack	7
rough	A,P	SEVEN	AA	slam(med)	11
round	AA	shock	7,P	slant(s)	10
route	A	shade	AA,P	slap(s)	13,P
row(s)	A,D	SHADS	1	slash	8,P
ruin(ed)	A	shaft	25,P	sleet	5
run(s)	AA,F,M	shake	A	slice(d)	30,P
rushed	AA,P	shall	AA	slick	3
rut	3,P,V	shape(d)	AA	slide	36,P
sale	AA,M	share	AA,P	slight	A,V
said	AA,V,D	sharp	A	slim	14
sail	AA,F	she('d) ('ll)		sling	8
SALVOS	-	('s)	AA	SLINGSHOT	-
same	AA,F,M	shear	12	slip(ped)	A,P
sand	A	SHECAT		slosh(ed)	-
sank	32,D	sheet(s)	A,V,D	slot	3,V
SAPPHIRE	6	shell(ed)	A	slow(ed)	A
sat	AA,P,M,V	shift	35	slug	5,P
SAUNTER	4	ship	AA,P	slung	3
save(d) (s)	AA,M	shook	A,P,M	small	AA
saw	AA,M,D	shoot	A,V	smash(ed)	12,P
say(s)	AA,F,M	shore	AA	small	A
scan(ned)	8,P	short	AA	smoke(r)	AA
scoop	8	shot	AA,P,V	snap(ped)	49
scope	11	should(n't)	AA	snatch(ed)	27
score(d) (s)	A	show(n)	AA,D	sneak	10
scout	37,P	shower(s)	41	SNOOPER	-
scram	-	shroud	9	snow(ed)	AA,P
SCRAMBLE	17	shut(s)	A,P	snub	2
scrap(ped)	18	sick	AA,P,F,M,V	so	AA,P,D
scrape(d)	18	side	AA,P,F,V	soar	12,P
scratch	30,P	SIERRA	3	sod	10,P,F,V
screen(ed)	39	sight	AA	soft	AA
screw	20	sign	AA,P,V	sole	25,D
scrub(bed)	14,P	silk	A	solve(d)	33,P
sea	AA	since	AA	some	AA
seal(ed)	45,F	SINGLE	AA	soon	AA,F,V
search(ed)	A	sink(s)	A,F	sought	-
seat(s)	AA,F,M,V	sit(s)	AA,P,F,M,V	sound	AA
SECTOR	2	site(s)	21	soup(ed)	36
SECURITE	-	SITREP	-	SOUR	15,P
see	AA	six(th)	AA	source	A
seek	AA,M	size	AA,P	south	AA,P
seem(ed)	AA,M	ship(ped)	17	space(d)	AA
seen	AA,M	skirt	A	span	13,V
seize	A	SKUNK	13	spare	A
self	A				

EXHIBIT 26 (Continued).

speck	13	strap(s)	15,P	TALLY-HO	-
speech	AA	stray(ed)		TANGO	-
speed(s) (-d)	A	(s)	18	tank(ed)	19
spent	A	streak(ed)	15	tap(ped)	32,P,M,V
spill	12	steam(ed)	AA	tape	8,V
spin	24,V	street	AA	TARCAP	-
splash(ed)	20,P	strength	AA	TARGET	9
split(s)		stress(ed)	13,P	task	A
(ting)	26	stretch(ed)	A	TASP	-
spoke	AA	strict	12	tear	AA,M
SPOOFER	-	strike	AA	tease	14,M
spool(ed)	7	string	A	tell	AA,P,F,V
spot(ter)		strip	A	ten	AA,P,F,M,V
spcut	6	stripe(d)	14	tend	A,F
spread(s)	AA	strive	19	tenth	23
spring	AA	strong	AA	test(s)	A,P,F,M,D
sprint	1	stuck	34	than	AA,P,D
spun	12,V	strung	2	tnank(s)	AA,P,D
spur	23	strut	8	that	AA,P
squall(s)	4	stuck	34	thaw(ed)	8,P,M,D
SQUAWK(ING)	4	stud	8	the	AA
square	AA	stuff	A,P	their(s)	AA
squeal	5	sub	1,M	them	AA,P
squelch(ed)	-	SUBCAP	-	then	AA,P,M,D
squib	-	suck	AA,P	there('s)	AA,P
stack	11,V	sun	AA,F,M	these	AA
stalk(ed)	27,V	sunk	17	they('d)('ll)	
stall	19,V	sure	AA	('re)('ve)	AA
stand(s)	AA	surf	4	thick	A,P,D
star(s)	AA,V	surge(d)	12	thickened	5
STARBOARD	3	swamp	29	thin	AA,P,D
start(s)	AA,P	swap	2	thing	AA,D
state	AA	sway(ed)	36	think	AA
stay(s) (ed)	AA	sweep	44	third	AA
STEADY	A	sweet	AA	this	AA,P
steep	40	swell	A	those	AA,P,D
steer	33,V	swift	43	though	AA,P,D
stem	39	swing	A	thought	AA
stick(s)	AA,V	swirl	7	thread	A,P
stiff	44,P	switch(ed)	15	threat	17
still(ed)	AA,V	swoop(ed)		three	AA,P
stink(s)	4	(s)	7	throw	A
stood	AA	tab(s) (bed)	1,P,M	thrust	40
stop(ped)	AA	tad	-	thud	4,P
store	AA,V	tag	7,P	THU-REE	-
storm	AA	tail	A,F	tide(s)	46,F
straight(en)	AA	take	AA,P,F	tie(d)	AA,V
strain(ed)	A	talk(ed)	AA	tight	35,
STRANGER	A	tall	AA,V	till	AA,F,M,V
STRANGLE	3				

## EXHIBIT 26 (Continued).

tilt	12,P	two	AA	WEATHER	AA
time	AA,P	type	AA,V	weave	22,P
tip(s)	A, P,F,M,V			week	AA
tire	AA,P,F	UNABLE	37	weigh	A
t'll	-	UNIFORM	A	weight	AA
to	AA,V	UNKNOWN	A	well	AA,F
told	AA,F,M	up	AA,P	went	AA,F,M
ton(s)	49,P	us	AA,P	were	AA
tone	A,V	use(d)	AA,P	west	AA,F,M
too	AA			wet	A
took	AA,F,M	vague	20,P	what	AA
TOOL	40,V,D	van	29	wheel(s)	A,P
top(ped)(s)	AA,F,M,V	vane	3	when	AA
torque	-	vary	A	where	AA
toss(ed)	46	vast	A,P,D	which	AA
touch(ed)	AA,P	VECTOR	-	while	AA
tough	18	veer	3	whine(d)	11
tow(ed)	9	vent(s)	7	whip	41
toward	AA	verge	9	whirl	31
tower	A	VERY	AA	WHISKEY	9
town	AA,V	via	8	white	AA,P
trace	A	VICTOR	11	who	AA,P
track(ed)	A	view(ed)	AA	whole	AA
TRACTORS	12	VISIBILITY	1	whose	AA
trait	7	voice	AA	why	AA,P
trade	AA,P	void	12,P	wide	AA,P,F
TRAILOR	-	volt(s)	2	width	28
train	AA			wield	6,P,D
TRANSPONDER	-	way	12,P	wild	AA,P
trap(ped)	42	wait	AA,P	will(-on't)	AA,F,M
trash	3,P	wake	A, P,F	win	AA,F,M
TRIDENT	1	wall(ed)	AA,D	wind	AA
tried	AA	wane(d)	7	wind	AA
trim(med)	42	want	AA	wing	AA
trip(ped)	AA,P	warm(ed)	AA	wipe	45,P
troop	A,P	warn	A	wire	A,P,F
TROT	21	warp	12	wish(ed)	AA,P
true	AA,P	was	AA	with	AA,P
trunk	48	wash(ed)	AA,P	word	AA
try	AA	waste	AA,P	work(ed)	AA
tuck	22,P,F	watch	AA,P	worn	A,F
tug	16,P	watt(s)	2	worse	A
tune(d)	32,D	wave(s)	AA,P	worst	A
turn(ed)(s)	AA,P,V	way	AA,F,M	worth	AA
twelve	AA	we('d)('ll)		would(n't)	AA
twice	A	('re)(ren't)		wreck	41,P
twin	25	('ve)	AA	write	AA
twirl	3	weak	A,P	wrong	AA,D
twist	42	wear	AA	WUN	-

## EXHIBIT 26 (Continued).

X-RAY	2				
yank	2				
YANKEE	12				
yaw(ed)	-				
YELP	5				
yes	AA				
yet	AA,P,F				
yield	A,P,D				
you('d)('11)					
('re)('ve)	AA,P,D				
your(s)	AA				
ZERO	11				
zone	26,P				
zoom(ed)	-				
ZU.U	1				

## EXHIBIT 26 (Continued).

## B. PHRASES

air borne	creep by	form right	IN THE DARK
air brake	crew rest	form up	I STAY
air line		four miles	
air plane	DAVEY JONES	FREE LANCE	join up
air speed	day break	freeze line	joy stick
air start	DECK CLEAR	front side	
aisle seat	DECK FOUL	fuel dump	keep clear
alls calm	dense fog	fuel feed	keep pace
ANY FACE	dim lights	fuel flow	
arm guns	dive time	fuel gauge	lap belt
	dog leg	fuel pod	lead ship
bank left	dome light	fuel pump	left flank
bank right	down hill	full flaps	left side
base leg	down wind	full speed	left turn
BENCH MARK	drag chute	fuze box	light haze
BAY RUM	draw fire		light mist
big blow	drink fuel	G-force	light rain
BINGO FIELD	drop down	gas gauge	light snow
BINGO STATE	drop tanks	gear down	link up
blade pitch	dry tank(s)	gear up	live fuze
bleed air	dump fuel	glide path	locked down
block time	dump stores	good by	low boost
boards out		ground fire	low pitch
bomb bay	EASE TURN	gun fire	low run
bomb run	east bound	<u>guns free</u>	low side
brake out	east side	<u>guns tight</u>	low tide
break left	EMERGENCY SPACE	half flaps	
break off	exit time	hand crank	MACK NO
break right		hatch closed	MACK YES
break up	face mask	head wind(s)	main gear
bright light	face plate	<u>heads up</u>	main switch
brisk wind	fan jet	high boost	marsh land
build up	far side	high gain	mid course
burned out	fast cruise	high pitch	mild chop
buss box	FEET DRY	high side	
	FEET WET	high tide	new course
call back	full tanks	high wind	next turn
call sign	class	hold course	<u>no joy</u>
calm sea	's	hold fire	north bound
calm wind	flame out	hold line	north east
CEASE REPORTING	flaps down	home plate	north west
change speed	flaps up	home stretch	nose gear
charge guns	flat tire	hook down	
chase plane	flight deck	'JTEL FIRE	off course
clear air	flight path	hot mike	on course
cloud deck	flight plan		ON THE CLOCK
cloud layer	flood light	ice berg	on top
coast line	<u>fly at</u>	iced up	ON STATION
code book	FLYING AT	I GO	ON TARGET
code three	form left	in range	

EXHIBIT 26 (Continued).

pins in	test flight
pins out	thank you
port side	thick clouds
PREP CHARLIE	three lights
prop jet	TIED ON
prop wash	tight turn(s)
purge tanks	time hack
	tip tank(s)
right flank	touch down
right side	tree top(s)
right turn	trim pad
run up	turn left
	turn right
safe guns	
SAINT BERNARD	warm up
SCENE COMMANDER	WARNING RED
SEE YOU	WARNING WHITE
set course	WARNING YELLOW
shore line	WAVE OFF
shut down	WEAPONS FREE
side slip	WEAPONS TIGHT
sign off	west bound
sink rate	WHAT LUCK
skip bomb	WHAT STATE
SKIP IT	wheels down
slow count	wheels up
slow cruise	wheels well
slow down	WHICH TRANSPONDER
slow flight	wide turn
slow roll	wing man
snap roll	wing tank(s)
south bound	
south east	YELLOW JACKET
south west	you're hot
speed brake	
spin out	
split-S	
spool down	
squall line	
STATE CHICKEN	
STATE LAMB	
STATE TIGER	
STATE WEAPONS	
steep turn	
steer course	
storm line	
stow pins	
tail hook	
tail wheel	
take care	

EXHIBIT 27: ARMY (TACTICAL FIELD) TEST MESSAGES.

QUESTION TYPE

- Q 1. What is the condition of the team?
- Q 2. What is size of enemy force?
- Q 3. Are elements in position?
- Q 4. What is fire mission?
- Q 5. How copy?
- Q 6. What is sit-rep?
- Q 7. Request log-stat.
- Q 8. Have you reached the objective?
- Q 9. What is your location?
- Q 10. Do you need air support?
- Q 11. What is your position?
- Q 12. Are you ready to move into position?
- Q 13. Is your area secured?
- Q 14. Do you need rations?
- Q 15. Are you in contact with the other team?

ANSWER/INSTRUCTION TYPE

- A 1. We need a resupply of ammunition.
- A 2. Move to LIMA ZULU vicinity 679703.
- A 3. You will be extracted at 1600 hours tomorrow.

EXHIBIT 27 (Continued).

- A 4. Am in contact with the platoon sized element.
- A 5. We drew heavy ground fire on the alternate LIMA ZULU.
- A 6. Abort the mission.
- A 7. We have reached the objective - in process of surrounding it.
- A 8. First insert ship shot out.
- A 9. My position from reference point is right one, down four.
- A 10. Need dust off. From check point one down two, left three. Will throw smoke. Have him come up on Battalion Command.
- A 11. I see your smoke. You are approximately one thousand meters from the LIMA ZULU.
- A 12. Am receiving heavy fire from the ridge line to the North.
- A 13. Put the napalm in the bottom of the valley.
- A 14. Ready with smoke - the first stick on final now.
- A 15. Fire for effect.
- A 16. Proceed immediately to point ZULU for extraction of element. Upon completion of extraction, initiate plan CHARLIE.
- A 17. Sit-rep negative.
- A 18. Attack enemy at 532714 at 0600 hours.
- A 19. Need interpreter and MI team at 546823 at 2100 hours.
- A 20. Move your unit to 633721 and defend. Prepare to attack.
- A 21. Be prepared for a CHARLIE ALPHA. Will give details later.
- A 22. Estimated ECHO TANGO ALPHA of resupply is 2200 hours.
- A 23. We are moving into NOVEMBER DELTA PAPA.
- A 24. Switch over to alternate frequency.
- A 25. From target ALPHA FOXTROT 2011, direction 1540, right 400, add 200, up 30. Infantry platoon in trenches. VT in effect. Adjust fire.
- A 26. Grid 627938, ranging rounds, adjust fire.

EXHIBIT 27 (Continued).

- A 27. From registration point 1, direction 1200, right 400, add 150. Enemy convoy, WHISKEY PAPA and HOTEL ECCO. Fire for effect.
- A 28. Search and destroy area 726650.
- A 29. Have discovered an enemy bunker system.
- A 30. Registration point 2, direction 2600, registration adjust fire.
- A 31. Hold enemy at 630725.
- A 32. Command post located at 722804.
- A 33. Friendly casualties KIA 9, WIA 13, MIA 2.
- A 34. Need airborne psywar team at \_\_\_\_\_.
- A 35. This frequency compromised. Change to alternate.
- A 36. We need immediate air support. Our situation is critical.
- A 37. We need 3 cases of Charlie 4 to destroy tunnel system.
- A 38. Need ammunition.
- A 39. Aircraft in vicinity.
- A 40. Observe radio silence.
- A 41. Call me on land live at 2000 hours.
- A 42. Have located large cadre consisting of food and ammunition.
- A 43. Have started to reach village.
- A 44. Trains located at 543202.
- A 45. Have consolidated as of 1500 hours.
- A 46. Grid 233629, Enemy patrol, fire for effect at my command.
- A 47. Maintain 75% until 0930 hours.
- A 48. Report to my location by 2100 hours.
- A 49. Send chaplain.

## EXHIBIT 28: 150 FLIGHT DECK PHRASES.

These 150 phrases were fabricated by Roy Klumpp to obtain speech material which would be similar to that which might be delivered over the Flight Deck Radio Link System.

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| 1. USE THE OTHER CREW               | 47. PULL OUT THE PIN            |
| 2. THE PILOT SAYS IT'S DOWN         | 48. WHAT WAS THE MESSAGE?       |
| 3. KNOCK OFF THE CHATTER            | 49. CRASH ON THE FAN-TAIL       |
| 4. THE FORE IS OUT NOW              | 50. WHAT CHANGE SHOULD WE MAKE? |
| 5. WHERE IS THE PLANE CAPTAIN?      | 51. NUMBER ONE IS NOT WORKING   |
| 6. I CAN'T HEAR YOU                 | 52. WHERE IS THE BEST PLACE?    |
| 7. TRY TO FIX IT FORWARD            | 53. SEND 10 MEN FORWARD         |
| 8. THE DECK IS SLIPPERY             | 54. FIRE THE PORT CAT           |
| 9. HE LOST HIS GOGGLES              | 55. CUT THE LINE                |
| 10. SEND FOR THE MEDIC              | 56. CALL THE ARMAMENT PARTY     |
| 11. TAKE 103 AFT                    | 57. WATCH OUT FOR JET BLAST     |
| 12. WE NEED AN AIR STARTER          | 58. TWO AD'S AT FRAME 51        |
| 13. WHAT IS THE WIND?               | 59. WE NEED THREE BRIDLES       |
| 14. BRING 6 BRIDLES                 | 60. THE TAIL HOOK WON'T RETRACT |
| 15. DROP IT DOWN #1                 | 61. SPOT IT NEXT TO 107         |
| 16. WAVE ONE HAND                   | 62. TRY OUT THE FORWARD ONE     |
| 17. ARE YOU READY?                  | 63. CHECK FOR FUEL LEAKS        |
| 18. HE BROKE HIS ARM                | 64. WE NEED A HOSE              |
| 19. SEND FOR A PUSHER CREW          | 65. LOAD ROCKETS ON 120         |
| 20. THE WIND IS 33 KNOTS            | 66. JONES SAYS 212 IS DOWN      |
| 21. HAUL IT BACK HERE               | 67. HOLD THE NEXT PLANE         |
| 22. FIRE IN THE PORT CATWALK        | 68. WATCH OUT FOR THAT WIRE     |
| 23. THE COD IS READY                | 69. FLY 2 IS HURT               |
| 24. HYDRAULIC LEAK ON THE F4J       | 70. NUMBER 110 IS DOWN          |
| 25. MAKE IT TWO FEET LONG           | 71. USE NUMBER 3 ELEVATOR       |
| 26. RAISE YOUR RIGHT FOOT           | 72. HOW MANY DID YOU SAY?       |
| 27. A MIRROR LIGHT IS OUT           | 73. HURRY UP FORWARD            |
| 28. FUEL LEAK ON THE A7             | 74. SEND US TWO TRACTORS        |
| 29. WHERE IS THE FLIGHT DECK CHIEF? | 75. LAUNCH AT 0910              |
| 30. MY RECEIVER IS DOWN             | 76. WHERE IS MR. JOHNSON?       |
| 31. OUR JOB IS DONE                 | 77. RAISE YOUR RIGHT HAND       |
| 32. GIVE ME A SLOW COUNT            | 78. ITS AT THE NUMBER 3 SPOT    |
| 33. READY TO LAUNCH NOW             | 79. HOW MANY DID YOU WANT?      |
| 34. TIE DOWN 204                    | 80. CARRY IT UP HERE            |
| 35. NUMBER TWO IS FLYING            | 81. CASUALTY AT THE MIRROR      |
| 36. SEND US A MAN                   | 82. BRING US SCME GLOVES        |
| 37. PRI FLY SAYS NO                 | 83. SEND M.A. AVERY DOWN        |
| 38. BRING UP # 1 ELEVATOR           | 84. FIRE DRILL AT 0700          |
| 39. BRING A HAMMER                  | 85. WHAT COLOR IS IT?           |
| 40. BOMB CRATER AT FRAME 62         | 86. OUR TRACTOR IS DOWN         |
| 41. SECURE THAT FIRE HOSE           | 87. CHANGE THE REAR TIRE        |
| 42. WHAT PLANE IS NEXT?             | 88. COVER IT WITH SAND          |
| 43. CALL ME LATER                   | 89. FIRE NUMBER 2 FIRST         |
| 44. GET BEHIND THE ISLAND           | 90. GAS UP THE AD'S             |
| 45. PULL OUT 005                    | 91. HOW MANY ARE LEFT?          |
| 46. FLAT TIRE ON 211                | 92. START UP 607                |

EXHIBIT 28 (Continued).

- |                                       |  |
|---------------------------------------|--|
| 93. THE TIME IS 1000                  | 123. FOUR MEN ARE NEEDED               |
| 94. WHERE'S 102 AT NOW?               | 124. CHECK FOR STICKING CONTROLS       |
| 95. BRING 3 FLASHLIGHTS               | 125. HOW MUCH FUEL IS LEFT?            |
| 96. OPEN UP THE BOX                   | 126. BOTH WINGS ARE GONE               |
| 97. NUMBER 27 IS FUELED               | 127. SEND FOR MORE BATTERIES           |
| 98. LAUNCH THEM NOW                   | 128. THE PORT WING IS DAMAGED          |
| 99. START ENGINES IN FIVE MINUTES     | 129. 713 IS DUE NEXT                   |
| 100. 101 MADE A TOUCHDOWN             | 130. WHY IS IT DOWN?                   |
| 101. FLY-1 IS GONE                    | 131. HOW MANY DO YOU WANT?             |
| 102. 90 POUNDS OF AIR PRESSURE        | 132. WHAT WAS THE PRESSURE?            |
| 103. BOMB HOIST NUMBER 2 IS OUT       | 133. THE WIND IS 41 KNOTS              |
| 104. PORT CAT IS NOW WORKING          | 134. CHANGE THE TIRE NOW               |
| 105. HOW MANY HELMETS?                | 135. SEVEN JACKETS, TWO HELMETS        |
| 106. HOLD HIM FOR 6 SECONDS           | 136. DROP THAT WIRE                    |
| 107. GET THE FIRE HOSE OUT            | 137. BOMB LOADING IN 10 MINUTES        |
| 108. TURN ON YOUR LIGHT               | 138. FRAYED ARRESTING GEAR WIRE        |
| 109. PREPARE FOR BOMB LOADING         | 139. THE TAIL FIN IS DAMAGED           |
| 110. FIND OUT WHAT THE FUEL STATUS IS | 140. THE BULL HORN ISN'T WORKING       |
| 111. HOLD 105 FOR 2 MINUTES           | 141. WHERE IS THE ARMAMENT CREW?       |
| 112. FUEL LEAK ON 111                 | 142. GIVE ME A WAND                    |
| 113. PREPARE FOR LAUNCH.              | 143. GET THAT PLANE MOVED              |
| 114. FIRE DAMAGE PARTY AFT            | 144. NUMBER 3 ARRESTING WIRE IS BROKEN |
| 115. ERECT THE CRASH BARRIER          | 145. IT'S AT FRAME 103                 |
| 116. TRACTOR 5 IS BELOW DECK          | 146. BRING FOUR CHOCKS ALOING          |
| 117. SEND ME A RUNNER                 | 147. G. Q. IN 10 MINUTES               |
| 118. SET FOR 40,000 POUNDS            | 148. CHECK THE BLAST DEFLECTOR         |
| 119. TURN OFF THE LIGHTS              | 149. PULL OUT THE CHOCKS               |
| 120. FIND OUT WHAT TIME WE LAUNCH     | 150. WHAT IS THE WIND?                 |
| 121. HE BROKE A LEG                   |  |
| 122. BOMB HOLE IN NUMBER 2 ELEVATOR   |  |

# EXHIBIT 29: FLIGHT DECK WORDS.

- 1) The Flight Deck Words were taken from the Flight Deck Phrases listed in the preceding section.
- 2) No proper names or station identification names were used.
- 3) No word appears more than once.
- 4) Each order is a different randomization of the same 100 Flight Deck Words.
- 5) There is a total of 10 orders.

## ORDER 1

1. spot	26. frame	51. elevator	76. degrees
2. launch	27. you	52. have	77. send
3. tractor	28. wing	53. starboard	78. off
4. take	29. flight	54. clear	79. island
5. bay	30. next	55. tell	80. forward
6. time	31. fuel	56. feet	81. facing
7. ready	32. number	57. mirror	82. airborne
8. room	33. position	58. pulled	83. standby
9. call	34. port	59. spotted	84. by
10. fly	35. control	60. repeat	85. back
11. pilot	36. same	61. topside	86. helicopter
12. secured	37. up	62. hop	87. minute
13. catapult	38. gear	63. fire	88. line
14. behind	39. hydraulic	64. phrase	89. sitting
15. right	40. radio	65. tail	90. side
16. nose	41. rudder	66. down	91. where
17. when	42. cat	67. knots	92. lit
18. low	43. leak	68. center	93. place
19. alongside	44. what	69. pusher	94. wind
20. taxi	45. outboard	70. inform	95. between
21. check	46. aircraft	71. cable	96. moving
22. deck	47. go	72. angel	97. belay
23. aft	48. manned	73. blue	98. we
24. gave	49. demon	74. drop	99. now
25. never	50. standing	75. crew	100. is

**EXHIBIT 30: TYPICAL MESSAGES IN THE SHIPBOARD AVIATION MAINTENANCE/  
SUPPLY RESPONSE LOOP, FROM NAVSHIPS (1972).**

- Link 4 "Stop work on tail 104 and  
go to work on tail 108  
located at \_\_\_\_."
- P/N\_\_\_\_ not in pool                      P/N = Part Number  
or need non-pool  
P/N\_\_\_\_."
- (Initial removal action,  
bad part from Supply  
or after QA.)                      QA = Quality Assurance
- Link 5 "Part required with  
priority\_\_\_\_, P/N\_\_\_\_."
- "Exchangeable part will be  
ready for pick-up at \_\_\_\_."  
(bulky items)
- "P/N\_\_\_\_ obtained from pool."
- "P/N\_\_\_\_ is available at  
[location]."
- Link 6 "P/N\_\_\_\_ (required/obtained from pool)  
with PRI\_\_\_\_ and Requisition\_\_\_\_." PRI = priority
- "Part not available. Status is (AIMD, NIS). Due  
in on \_\_\_\_."                      NIS = Not in Stock
- "Reminder to turn in defective items."  
"FIN for Requisitions\_\_\_\_." (Items which  
require lock-up.)                      FIN = Federal Index Number
- "AWP part has arrived."
- Link 7 "Part is/is not available."
- "AWP has arrived."
- "Part Requisition  
with PRI\_\_\_\_  
and P/N\_\_\_\_."
- "Part available                      "Part not available"  
   or  
at \_\_\_\_."                      and status.
- "AWP material is available."
- Link 8 "AWP material is available at \_\_\_\_ [location]."  
"Material available/not available; delivery  
instructions and part status."
- "Requisition P/N\_\_\_\_, Requisition Number\_\_\_\_,  
JCN\_\_\_\_." (SRA and bits and pieces not  
in MSP.)

## TYPICAL NAVAL NOISES

Unless an equipment is to be tested in its actual environment, as specified in the U. S. Army report (1971), simulated or recorded noises must be added to the test environment. Except for tests in the actual environments using operational personnel, the most valid tests are with talker(s) and listener(s) communicating naturally (no aids to constant voice level, etc.) using the test equipment(s) in a surrounding simulated ambient noise environment. Although records should be kept of talker and listener levels, the communicators should be allowed to choose their own levels. Exceptions to this occur when the talker or the listener level is a parameter under test. Expediency often dictates, however, that a tape recorder be used to record the talker and, at a later time, to play back to groups of listeners.

Feedback to the talkers, unless it is an experimental parameter, should be as it is in the system as actually used. This is highly important, as is the freedom given to the talker of adapting his own vocal effort level. Talkers adapt their levels (1) to the ambient noise levels they are in, (2) to the levels of sidetone (feedback) they receive in their own ears of their own voices, (3) to the contextual situations they are in (one or many listeners, routine or emergency communication scenario, etc.), and (4) to their emotional states (bored, fatigued, excited, angry, scared, fearful, etc.). To the extent possible, these factors must be accounted for.

## AIRCRAFT NOISES (COCKPIT)

Figure 3 shows "averaged" noise spectra of three types of aircraft, from Sutherland and Gasaway (1971) based on Gasaway (1969, 1970). In all cases individual cockpit noises of the noisier aircraft were between 10 and 15dB higher; see Gasaway (1969, 1970) for details and spectra on individual aircraft types. For typical worst-case conditions, these spectra should be reproduced at levels of about 110dB(A) at the position of the head of the talker and/or listener.

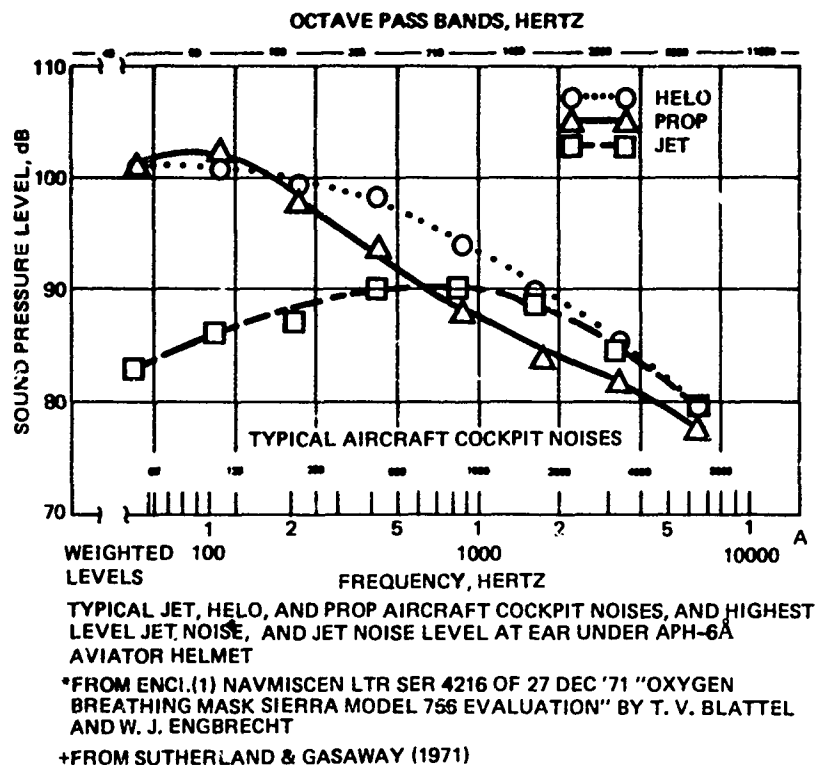


Figure 3. Typical aircraft cockpit noises.

#### AIRCRAFT NOISES (EXTERNAL)

Figures 4 and 5 show the spectra of an F4 (Phantom) aircraft running at military power and in afterburner at measured distances of 12.5, 25, 50, 100, and 200 feet at an angle of 60 degrees off the nose. For levels at other angles around the aircraft and for spectra of other jet aircraft see Webster (1971) or the original data sources, Seltz (1961a, 1961b) and Abell (1963a, 1963b).

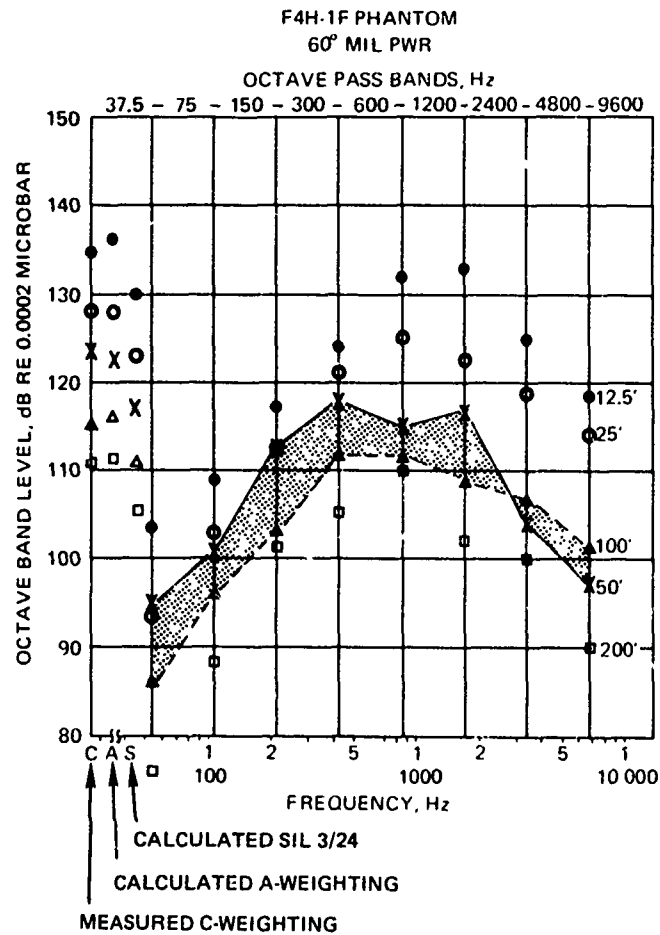


Figure 4. Octave-band noise levels of F4 aircraft running at military power.

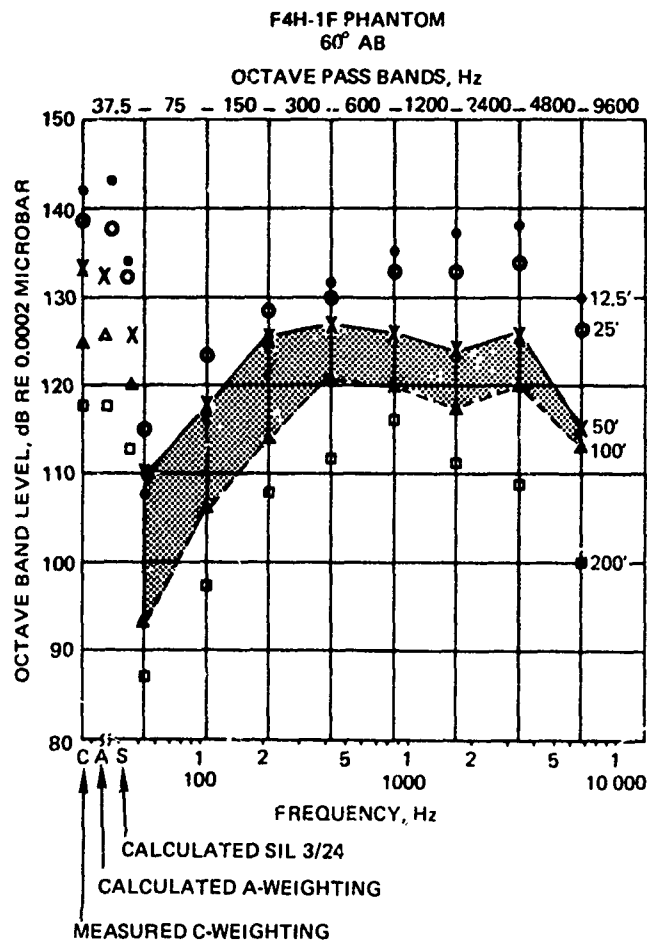


Figure 5. Octave-band noise levels of F4 aircraft running in afterburner.

## SHIP NOISES

Except for aircraft noises on ships with jet, propeller, or rotary wing aircraft, the primary ship noises are in the engine room, from ventilating blowers and ducts, from other people talking or listening to music, or from general ship rumble. Spectra of these noises are shown in figures 6-9 at levels that have been adjusted to be equally speech interfering (see Klumpp and Webster (1963)) but not necessarily typical of ship levels. Engine room noises are typically between 95 and 105dB(A); blowers and rumble from 55 to 70dB(A), depending on distance from source, ship speed, etc.; and voice babble from 55 to 80dB(A) depending on the ambient noise in the space in the absence of people.

To test equipment in these noises, use the worst-case or the highest levels just cited.

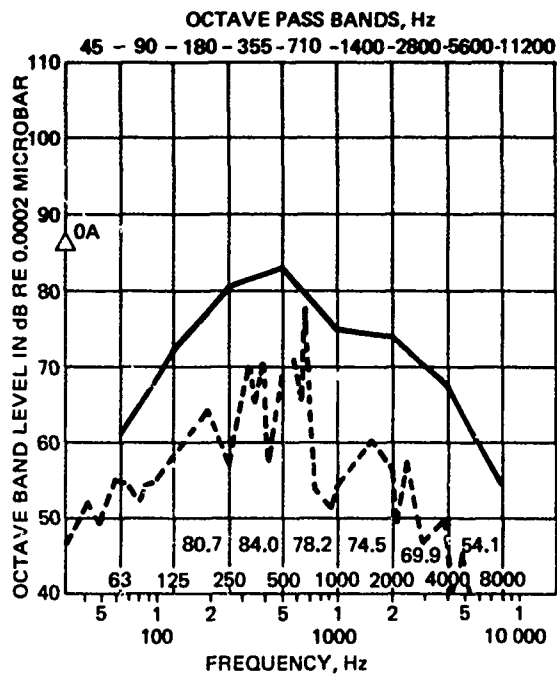


Figure 6. Octave-band and 20-Hz-band levels of engine room noise.

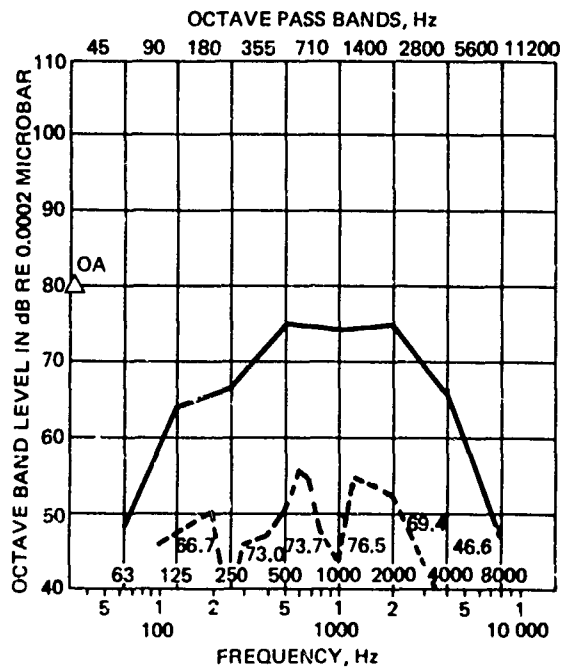
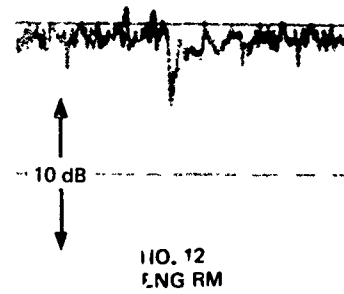
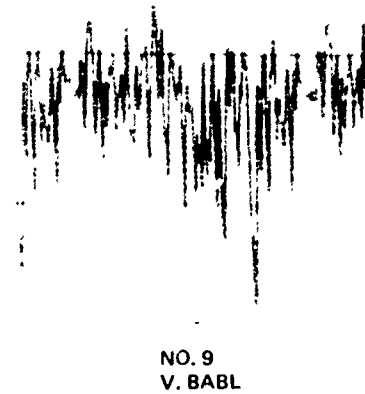


Figure 7 Octave-band and 20-Hz-band levels of voice babble.



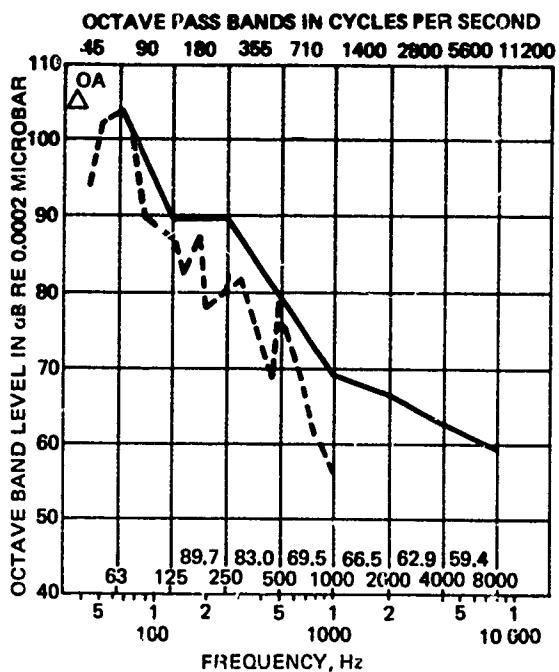


Figure 8. Octave-band and 20-Hz-band levels of ship's rumble.

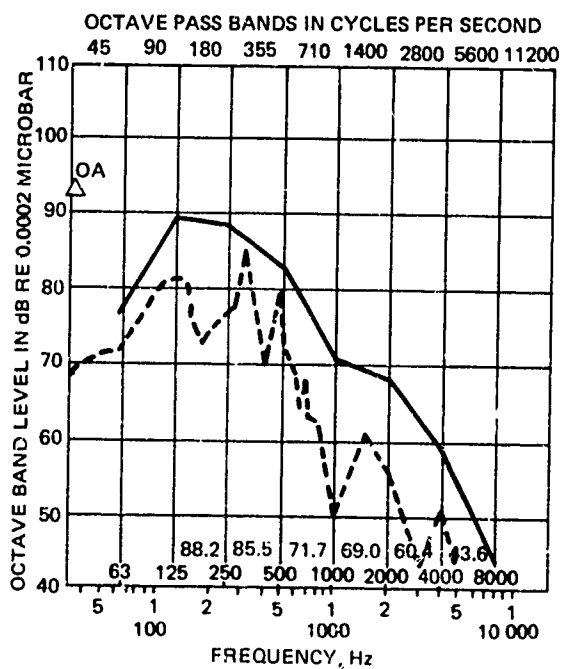
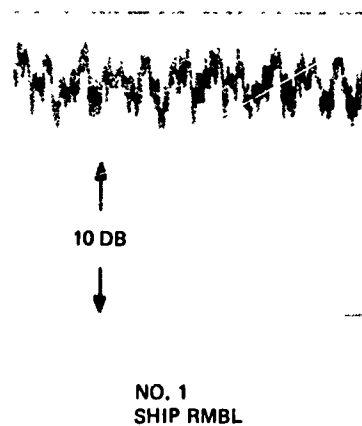


Figure 9. Octave-band and 20-Hz-band levels of blower noise.



## COMPARATIVE SCORES AMONG SPEECH MATERIALS

It is often (usually) the case that one speech test is the most appropriate (most efficient, least time consuming, requiring least training of talker/listeners, etc.) but the least amenable to interpreting the results to design engineers, systems managers, or sponsors. For this reason many tests have been run primarily to relate the scores on one type of test to those on others. A few of the results from some of these comparisons are cited here for quick and easy reference.

### WORD VOCABULARY SIZE VS SENTENCES AND NONSENSE SYLLABLES

Figure 1 from Kryter et al (1963), adapted from French and Steinberg (1947), shows why using PB words is a dangerous test procedure. For the same physical conditions of speech-to-noise ratio, expressed as Articulation Index (AI), PB word scores may vary from 23% to 85%, depending on vocabulary size. Since vocabulary size, amount of training, etc., are not easy to specify and usually are not specified in detail, the use of PB words should be limited to such things as on-the-spot comparisons between two competing equipments.

There are at least two points of interest: (1) 1000 PB words are nearly as difficult, or discriminating, as nonsense syllables and even though difficult to use are still preferable to nonsense syllables with regard to training time, etc. (2) 32 PB words are easier, even less discriminating than sentences, and to a first approximation it would probably be safe to generalize that scores on one or two PB lists (50 to 100 words) are equivalent to sentence, or everyday connected discourse, scores

### NAVY VS CIVILIAN SPEECH

Montague (1960) found that Pseudo Navy Sentences gave generally equivalent scores, as did Navy Civilian Sentences and Phonetically Balanced Words. Sentence scores were generally 10 to 20 percentage points higher than word scores. He also compared the Fairbanks Rhyme Test (FRT) word scores with the other scores and found FRT scores to be generally equal to sentence scores.

### RHYME TEST SCORES VS PB SCORES

Kryter and Whitman (1965), using data from Miller, Heise, and Lichten (1951) and Nickerson et al (1960), conclude that scores on Rhyme Tests (Fairbanks (1958) and House et al) are generally equivalent to scores on 256 PB words. Webster and Allen (1972) show that Rhyme Test scores are generally equivalent to scores on Brevity Code words (including digits and the ICAO phonetic spelling words). Combining the data of all these studies, with the addition of a few approximations, gives the relationships shown in figure 2

The relationships shown above allow generalizations from test words to actual operational words or phrases so that efficient tests can be administered and generalized interpretation can be made.

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